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Cover Page Footnote

The first author is most thankful to David Gosling, former Huron Mountain Wildlife Foundation (HMWF) Director, for approving the initial proposal to survey leaf mining insects, guidance to various habitats, and encouragement to continue surveying even when recoveries were at first unexpectedly few. Kerry Woods (Bennington College, Vermont), current HMWF Director, is also sincerely thanked for his continued support and patience with this work. RJP is also most grateful to the Huron Mountain Wildlife Foundation for its years of financial support for field work. RJP is also most indebted to William and Anne Manierre (both recently deceased) for sharing their lifelong knowledge of HMC sites, guidance to a variety of them, personal friendship and encouragement, and their most generous hospitality during my years of visits. Additionally, RJP very much appreciated Fred Rydholm's (deceased) guidance over lands and his eagerness to share the history of the HMC, its world renowned visitors, and his friendship. RJP also thanks Wayne Thorpe, HMWF manager, for his historical knowledge and assistance arranging accommodations at Stonehouse, the research facility. To Frederick W. Stehr (Emeritus curator, MSUC), RJP is indebted for initially inviting him to work at the A.J. Cook Arthropod Research Collection at Michigan State University (MSU) as an Adjunct Curator. Indebtedness is also owed to Anthony Cognato, current Collection Director for his continued personal and financial support for visits to the National Museum of Natural History to identify specimens and for reviewing a later draft of this manuscript. Continued work in the collection would not have been possible without the assistance of Gary Parsons, Collection Manager, and his continued encouragement in my effort to focus on leafminers. The following taxonomists have most willingly given their time and expertise for this survey: Stéphanie Boucher, Macdonald Campus, McGill University and Sonia Scheffer, Systematic Entomology Laboratory, USDA, identified Agromyzidae; Jade Savage, Bishop's University, identified Anthomyiidae; Matthew Buffington, Systematic Entomology Laboratory (SEL), USDA described *Banacuniculus strykeri* Buffington; John Luffman, University of Minnesota, identified Ichneumonidae; Jean-Francois Landry, Canadian National Collection of Insects, Arachnids, and Nematodes, identified *Coleophora pruniella* and Vazrick Nazari of that same facility, determined Gelechiidae. David Adamski et al. (2014) (SEL) described *Scrobipalpula manierreorum* and provided the photograph of the holotype used in this paper. Gary Parsons confirmed identifications of Coleoptera; Norman E. Woodley, National Museum of Natural History, provided advice on differentiating *Brachys* species. Edward G. Voss (deceased), University of Michigan, identified various plant species. Donald R. Davis, NMNH, graciously allowed use of his draft revision of Gracillariidae. RJP is indebted to Sarah M. Smith, Adjunct Curator of Scolytines, Michigan State University, for photographing the adult specimens and arranging all photos into plates. Kasey Wilson, Map Library, Michigan State University, was most helpful in creating the general map of HMC in upper Michigan. We thank Gary Parsons and Bernice DeMarco for their reviews of an earlier draft of this manuscript and offering helpful improvements. We also thank two anonymous reviewers who offered helpful suggestions and significantly improved the later draft. RJP also acknowledges indebtedness to Eugene Rhodes Thompson (deceased) for his insightful question as this project began, "Are you taking pictures?" Finally RJP thanks his wife, Helen, for her patience during many absences, recording emergence dates, assisting on several field trips, and her constant support throughout these years of survey. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA. USDA is an equal opportunity provider and employer.

Leaf Mining Insects and Their Parasitoids in the Old-Growth Forest of the Huron Mountains

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Abstract

Leaf mining insects in an old-growth forest along the south central shore of Lake Superior in Michigan are documented. We present the results of a 13-year survey of leaf mining species, larval hosts, seasonal occurrence, and parasitoids, as well as report biological observations. Representative larvae, mines, adults, and parasitoids were preserved. Among the larval host associations, 15 are reported as new. Additionally, 42 parasitoid taxa were identified resulting in six first reports from the New World and 32 new host associations. Two undescribed species (Gelechiidae and Figitidae) discovered through this research were described in earlier publications.

Keywords: biodiversity, Chalcidoidea, Coleoptera, Diptera, Hymenoptera, Ichneumonoidea, Lepidoptera, Nearctic

The leafmining guild is an important ecological component of forest biodiversity. Leaf miners occur primarily among Diptera and Lepidoptera with only a few species among the Coleoptera and Hymenoptera (Needham et al. 1928). In their larval form, leaf miners feed inside one or more leaves for all or at least a portion of that stage. Their mining patterns can vary considerably among species, from a narrow sinuous trail to a large blotch encompassing the entire leaf. Mines may occur on the upper-, the lower-, or both leaf surfaces as the larvae grow. While a mine provides its inhabitant with a protective cover, it can also function as its prison. For example, miners have little escape from a variety of parasitic Hymenoptera that attack them. In spite of their variously shaped mines, their small size and unobtrusive feeding habits allow these insects to be easily overlooked as a subject of study in forest ecosystems.

One forest type in northern Michigan, is the Hemlock-White Pine-Northern Hardwoods which once encompassed over 15 million hectares (Frelich and Reich 1996, Dickman and Leefer 2003). This forest type extended “from northern Minnesota and extreme southeastern Manitoba through the upper Great Lakes region and eastward across southern Canada and New England”

(Braun 1950). A remnant of old-growth Hemlock-White Pine-Northern Hardwoods forest occurs within a private land holding called The Huron Mountain Club (HMC) located in the upper peninsula of Michigan (Fig. 1). Many of the components of this old-growth forest have been studied (see: www.hmwf.org/archives/reports/), however, not leaf miners.

The landscape of the HMC is composed of Precambrian metamorphic bedrock hills (Dorr and Eschman 1970, Simpson et al. 1990). “The metamorphic rock, much of it over 2.5 billion years old, is a part of the Canadian Shield and in the Huron Mountains has been differentially eroded to produce the current bedrock topography” (Simpson et al. 1990). Its physiography is one of hills in sharp relief, 10 intermontane lakes, and a diverse array of old-growth forests. Soils vary from nearly absent in mountain crevices to deep in the low flat lands and sandy along its beaches (Braun 1950). Cool temperatures and a low evaporation rate characterize the climate of HMC. Except for the first 3–5 km along Lake Superior, the lake does not significantly moderate land temperatures since prevailing winds are southwesterly (Denton and Barnes 1988).

Simpson et al. (1990) studied the landscape of HMC and divided the area into 29

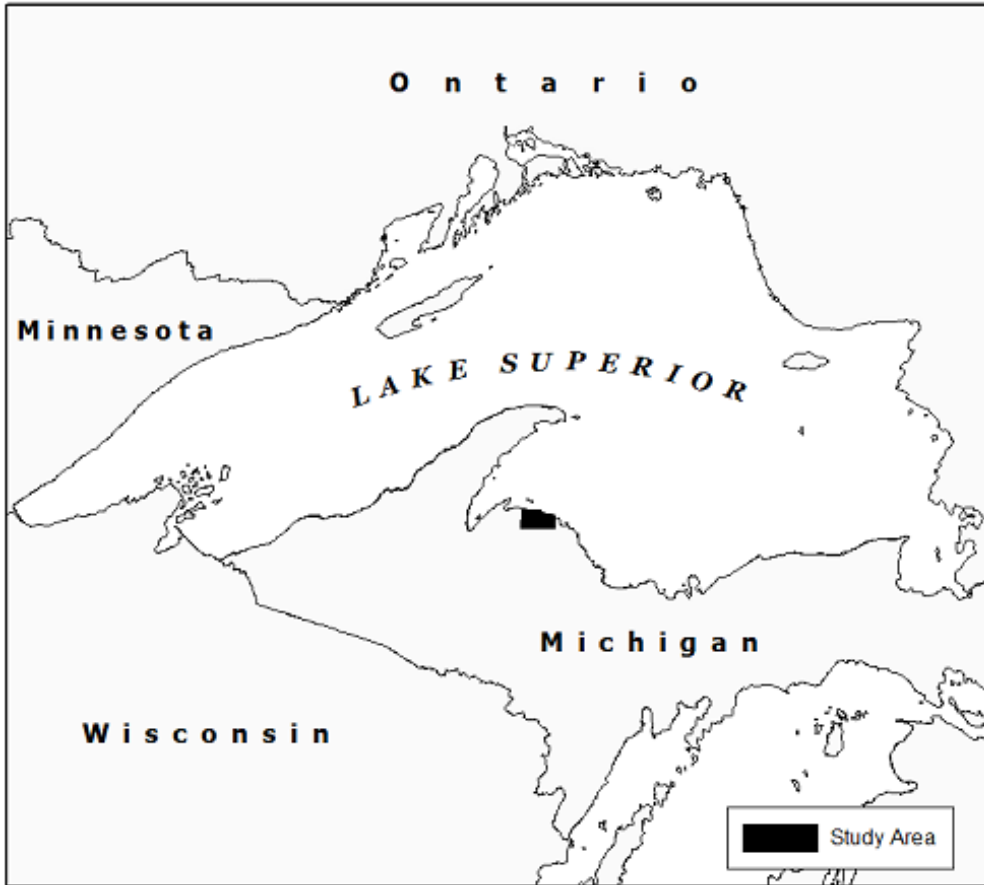


Figure 1. The Huron Mountain Club along south-central coast of Lake Superior in Marquette County, Michigan, U.S.A.

cover types with 22 upland types covering 94% of the area. Of those, the two larger cover types are hemlock-northern hardwood (49%) and lichen-juniper, pine-oak, and pine-hemlock hardwoods (30%). Other upland types include pine, birch-aspens, and wet site conifer and conifer-hardwood. The remaining wetland cover types include open and forested land. These cover types, with nine lakes and several streams, contribute to its diversity of life supporting leaf mining insects, their hosts, and parasitoids.

The main objective of our 13-year survey was to document leaf miners occurring in this old growth forest and associated cover types. For all leaf mining species we collected, larval host plants, seasonal occurrence, and parasitoids were recorded. A secondary objective is to report behavioral observations of the immature stages in this guild.

Materials and Methods

Three methods were used to locate leaf miner habitats: 1) advice from knowledgeable individuals who frequently guided the first author (RJP) to sites, 2) literature descriptions (Etter et al. 1960, Wells and Thompson 1976, Rydholm 1989, Simpson et al. 1990, Manierre 1999), and 3) exploration of areas via 2-track roads and walking trails. Habitats surveyed included fen, bog, beach, old field, stream flood plain, beech/maple forest, deciduous forest undergrowth, and some areas of disturbed ground along main roads. The sites were sampled for 93 cumulative sampling days from 2000–2012. For many sites sampling was conducted multiple times during various seasons and over multiple years. This provided a greater chance of collecting species that were rare or had fluctuating population numbers. Previous survey experience in upper Michigan by the first

Table 1. Huron Mountain Club survey dates and cumulative sampling days from 2000–2012.

Year	May	June	July	August	September	October	Cumulative Days
2000		25–30			25–29		10
2001		11–15			23–27		10
2002	08	24–28			23–27		11
2003		23	14–18		17–21		11
2004		09–13		16–20			10
2005				12–16			05
2006		05–09		15–19			10
2007		02–06		29	18–22		11
2008		23–27		27	24–25		08
2009				27		04	02
2010				28		11	02
2011					22		01
2012	31				25		02
Cumulative Days	2	36	5	19	29	2	93

author found a flush of miners early in the growing season, a reduction in July and August, and then the highest abundance in late summer and autumn. These observations guided the timing of the current surveys (Table 1). Rearing larvae from host foliage was the exclusive method for obtaining leaf miner data, including larval hosts, mines, immaculate adults, seasonal occurrence, and parasitoids. Active miners were recovered by visually searching leaves between 0–2 m above ground. Leaves containing similar mines from the same host species and location, termed a “lot”, were placed in a single quart-size freezer Ziploc® bag with a field identifying label. Each mine of taxa known to pupate outside its mine, such as Agromyzidae, Nepticulidae, and Tenthredinidae, were placed in separate bags when collected. Upon returning from the field each lot was assigned a unique sequential lot number, recorded on a separate rearing notes form. Each larva within each lot was also given a unique number preceded by its associated lot number. Issuing parasitoids were likewise numbered with their associated host’s number. All relevant data for each specimen were recorded on the rearing notes forms. Each leaf was placed in a separate bag with its assigned specimen number. All bags were held in translucent plastic gallon boxes fitted with air-tight lids. Mines were observed daily and data recorded on mine shape, feeding patterns, and larval habits.

When miners pupated in their mines, the mined leaves were placed in vials for adults to issue. Vials were glass 15 or 20 ml., with openings covered by nylon cloth and held in place with hollow plastic corks. Larvae pupating outside their mines were held in their individual bags until pupa-

tion occurred then placed singly on lightly moistened sand in vented glass vials. All vials were held in sealed gallon plastic boxes with slightly moistened paper toweling and checked daily for adult issue. Immatures recovered in the fall were wintered in bags or vials inside gallon plastic boxes in an unheated home garage. Wintering mines were examined weekly to confirm presence of adequate moisture. Boxes were brought indoors by mid-February to force adult emergence, which occurred between March and May for most overwintering individuals. Vacated mines were pressed, then preserved in glassine envelopes with a label containing lot number, host plant, and the mining species. Adult miners were double mounted (Landry and Landry 1994). Issuing parasitoids were killed, mounted on points, card-mounted (Noyes 1982), or preserved in 80% ETOH.

While larvae fed, representative mines were photographed (Priest 2007), and some were preserved as described by Stehr (1987). All microscopical observations were made using a Leitz Wetzlar wide-field stereomicroscope with eyepiece reticle. Images of adult miners were photographed and assembled with a Visionary Digital Passport II system (Palmyra, VA) using a Canon EOS 5D Mark II, 58.0 mm Canon Macro photo lens, Canon Speedlite transmitter ST-E2, two Canon Speedlite 4303X II flashes and a Stack Shot (Cognisys, Inc., Kingsley, MI) controlled by Zerene Stacker 1.04 (Zerene Systems LLC, Richland, WA). Montage images were assembled using Helicon Focus Mac Pro 4.2.8 (Helicon Soft, Kharkov, Ukraine).

Adult miners were identified primarily by the first author using the following literature: COLEOPTERA: Buprestidae: Wellso et

al. (1976), Bright (1987), Downie and Arnett, Jr. (1996), comparison with specimens at the A. J. Cook Arthropod Research Collection, Michigan State University (MSUC); Chrysomelidae: Parry (1974); Staines (2006); names used according to Clark et al. (2004). DIPTERA: Agromyzidae: mines of *Liriomyza robiniae* Valley tentatively identified with Weaver and Dorsey (1967) and Valley (1982); *Phytomyza plantaginis* Robineau-Desvoidy tentatively identified with Spencer (1973). HYMENOPTERA: Tenthredinidae: *Betula*-feeding species were identified using Digweed et al. (2009); other species identified using Smith (1971, 1988) and Hoebeck and Wheeler, Jr. (2005). LEPIDOPTERA: Argyresthiidae: identified with Freeman (1972); Bucculatricidae: identified with Braun (1963); Eriocraniidae: tentatively identified with Davis (1978, 1987) and Stehr and Martinat (1987); Gracillariidae: Dietz (1907), Braun (1908), Forbes (1923), Weaver and Dorsey (1967), and Maier and Davis (1989); Nepticulidae: Braun (1917) and Wilkinson and Scoble (1979); Tischeriidae: Braun (1972). Adult Lepidoptera were also compared with specimens at the USNM. Specimens from rearings which produced no adults were included and cited as “probably” (prob.) if the larva and mine were in concordance with known geography, seasonality, host plant, mine placement and shape, frass arrangement, larval color, and pupation site of the cited species. Plants were identified by RJP using Cobb (1963), Voss (1972, 1985, 1996), Wells and Thompson (1976), and Voss and Reznicek (2012).

The second author (RRK) identified all Braconidae using Leica Wild M10 and Leica M205 A stereomicroscopes with 10X or 25X oculars. All specimens were determined to genus using the relevant keys to genera in Wharton et al. (1997). Specimens were identified to species, when possible, using relevant keys listed in Yu et al. (2012). All species identifications were corroborated through comparison with specimens in the USNM identified previously by braconid systematists. Yu et al. (2012) was used for Braconidae and Ichneumonidae classification as a standard, but use of the classification herein should not imply that the authors agree with the placement or status of all taxa.

The third author (MWG) identified all Chalcidoidea using a Nikon SMV-1500 stereomicroscope with 10X oculars. All specimens were determined to genus by sight identification or using Gibson et al. (1997). Specimens were identified to species, when possible, using relevant keys listed in Noyes (2018). All species identifications were corroborated through comparison with authoritatively identified specimens in the

Smithsonian Institution National Museum of Natural History (USNM).

Most voucher specimens of adult miners, larvae, mines, and rearing note were deposited in MSUC. The remaining voucher specimens were deposited in the collections at the institutions of the experts providing those identifications (see Acknowledgments). Some host plants were deposited at the University of Michigan and Michigan State University herbaria. Though most plants were not vouchered at a herbarium, leaves with mines were pressed and placed in MSUC. Most preserved leaves and many of the illustrated mines show a sufficient amount of the host leaf to make plant identification possible. Lists of parasitoids reported from the hosts treated herein were obtained primarily from Noyes (2018) and Yu et al. (2012). Other sources are identified with the specific miner species' parasitoids discussed.

Results and Discussion

A total of 221 lots were reared resulting in 63 leaf miner taxa and 42 parasitoid taxa identified (Tables 2 and 3). Thirteen larval-host plant species associations and three larval-host plant genera associations are newly reported. Twenty leaf miners are reported as new to Michigan. *Scrobipalpula manierreorum* Priest (Gelechiidae) and *Banacuniculus strykeri* Buffington (Figitidae) were newly discovered during this survey and described prior to this paper. Additionally, we report the first rearing of *Chirosia spinosissima* (Malloch) (Anthomyiidae) from larva to adult. We also document miners from 38 plant taxa in 13 plant families. Forty-two parasitoid taxa in six families of Hymenoptera were identified with six New World records.

The plant survey by Wells and Thompson (1976) included approximately 90 square miles of the Huron Mountain range and identified an extant 781 species. In the current survey, mines were reared from only 41 plant taxa. The first author has observed, while surveying leaf miners throughout Michigan since 1997, that the farther north surveys occur, numbers of both species abundance and richness decline. As a result, longer periods are required in northern regions compared to southern regions of Michigan to obtain even modest results. The presence of vacated and unfamiliar mines during this survey suggests many additional mining species await discovery in this remarkable old growth land holding and throughout Michigan. We report data from each reared species below.

COLEOPTERA

Buprestidae

Brachys aerosus (Melsheimer) (Fig. 2, 3). **Specimen data:** Breakfast Roll Mountain 46°51.051N 87°49.601W, 2 larvae 25 Sep 2000, 3 adults after wintering, Lot 1088; same location, 4 larvae 26 Sep 2001, 2 adults after wintering, Lot 1261; River Styx 46°50.627N 87°51.300W, 10 larvae 27 Sep 2001, 3 adults after wintering, Lot 1247; same site, 2 larvae 25 Sep 2008, 2 adults after wintering, Lot 1905; Lily Lake 46°50.892N 87°49.783W, 4 larvae 26 Sep 2002, 3 adults after wintering, Lot 1361; same site, 2 larvae 16 Sep 2005, 1 adult after wintering, Lot 1658. **Distribution:** CANADA: AB, BC, MB, NB, ON, QC, SK; U.S.A.: AL, AR, AZ, CT, FL, GA, IA, IL, IN, MA, MD, ME, MI, MO, MT, NC, ND, NH, NJ, NY, OH, OK, PA, RI, SC, SD, TX, VT, VA, WA, WI, WV (Nelson et al. 2008). **Larval hosts:** Hardwoods, usually oak (Wells and Thompson 1976); *Acer* sp., *Castanea* sp., *Cornus* sp., *Fagus* sp., *Hamamelis virginiana* L., *Populus tremuloides* Michx., *Quercus* sp., *Tilia americana* L., *Ulmus* sp. (Bright 1987); *Quercus rubra* L. var. *ambigua* (Gary) Fern. (Nelson et al. 2008). Except for Nelson et al. (2008), the previous references do not specify hosts as either of larvae or adults. *Quercus rubra* (identified in this survey). **Parasitoids:** **Eulophidae:** *Closterocerus cinctipennis* Ashmead (Noyes 2018). **Remarks:** Only one mine per leaf, and a single larva in each mine was observed. Mining occurs as early as July with feeding continuing into October. The mine is a wide track beginning at the leaf edge progressing apically. There are usually three distinct sections visible when complete: an initial brown section, a middle dirty green section, and a terminal vague-green to near transparent section. The mine color changes may be associated with mine depth and possibly specific instars, which also agrees with this species' number of larval instars (Needham et al. 1928). By late feeding the initial mined area is frequently dried and has fallen away. Frass is initially deposited as particles, while frass in the third section consists of short strings. The larva winters in its mine, pupating there after winter. This observation differs from Weiss and Nicolay (1919) who observed larvae exiting mines to winter in soil. After wintering, the adult emerges from its mine within two weeks of pupation. In the field, adults were recovered maturation feeding in full sun on *Q. rubra* leaves from early June to mid-July. Only one generation per year was observed in this survey.

Brachys aeruginosus Gory (Fig. 4, 5). **Specimen data:** Flat Rock 46°54.520N

87°55.355W, 1 larva 24 Sep 2002, 1 adult after wintering, Lot 1351; same location, 6 larvae 12 Sep 2005, 2 adults after wintering, Lot 1646; Loop Road 46°50.627N 87°51.300W, 2 larvae 13 Sep 2005, 2 adults after wintering, Lot 1653; Quarry-Fen 46°53.839N 87°53.607W, 5 larvae 15 Sep 2006, 4 adults after wintering, Lot 1764; same location and date, 2 larvae 15 Sep 2006, 2 adults after wintering, Lot 1765; same location, 2 larvae 19 Sep 2007, 2 adults after wintering, Lot 1842. **Distribution:** CANADA: ON, QC; U.S.A.: AL, CT, DE, FL, GA, IA, IN, KS, MA, ME, MI, MO, NH, NJ, NY, NC, OK, SC, SD, TN, VA, WA (Nelson et al. 2008). **Larval hosts:** Elm (Hoffman 1942); oak (Wells and Thompson 1976); *Arbutus* spp., *Carpinus* spp., *Carya* spp., *Fagus* spp., *Salix* spp., *Ulmus* spp. (Bright 1987). Previous citations do not specify hosts as either larval or adult. *Acer saccharum* Marsh. (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** In six rearings *A. saccharum* was the only larval host plant observed. The mines are found most commonly in leaves of ground cover maples, named by Braun (1950) as the "maple reproduction layer." There is only one mine per leaf and one larva per mine. The full depth mine is a wide track; because the winding tracks are frequently contiguous, it may appear as an irregular blotch. The later feeding area is light green though most of the mine is tan colored. Short black string frass forms irregular trails. Some larvae were observed exiting the lower surface of their mine prior to wintering, but these specimens died. Larvae usually winter in their mines with pupation occurring after winter and adults issuing within two weeks of pupation. There is only one generation per year at HMC.

Chrysomelidae

Dibolia borealis Chevrolat (Fig. 6, 7). **Specimen data:** Ken Cass drive near Lily Pond 46°50.892N 87°49.783W, 9 larvae 14 Jul 2003, 0 adults, Lot 1414; near Lower Falls 46°48.720N 87°48.772W, 40+ larvae 08 Jun 2006, 0 adults, Lot 1701. **Distribution:** CANADA: AL, MB, NB, NS, ON, PE, QC. U.S.A.: AL, AR, CT, DC, FL, IA, IL, IN, KS, LA, ME, MD, MA, MI, MS, MO, MT, NH, NJ, NY, NC, OK, RI, SC, TN, TX, VT, VA, WV, WI (Parry 1974). **Larval hosts:** *Plantago major* L., *P. lanceolata* L., *P. rugelii* Decne. (Clark et al. 2004); *P. major* (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis nitetis* (Walker) (Noyes 2018). **Remarks:** Several mines were found per leaf but only one larva per mine. The mine is full depth, meandering and serpentine, with a black central frass trail. Two rearings of feeding larvae did not produce adults though adults were collected on mined leaves. The

Table 2. Reared leaf mining insects, hosts, and parasitoids. Acronyms are: FH = first reported larval host; NG = newly reported host genus; NO = newly reported Michigan occurrence; NS = newly reported host species. Months are divided into thirds: E (early) = 1st-10th; M (mid) = 11th-20th, L (late) = 21st to month end. Parasitoid numbers refer to Table 3.

Leaf Miner	Larval Host	Recovery Period	Emergence Period	Parasitoid Number(s)
COLEOPTERA				
Buprestidae				
<i>Brachys aerosus</i>	<i>Quercus rubra</i>	M-L Sep	wintered	
<i>Brachys aeruginosus</i>				
NG	<i>Acer saccharum</i>	M-L Sep	wintered	
Chrysomelidae				
<i>Dibolia borealis</i>	<i>Plantago major</i>	E Jun- M Jul	E Jun	
<i>Sumitrosis inaequalis</i>				
NS	<i>Eurybia macrophylla</i>	M Jul	E Aug	
DIPTERA				
Agromyzidae				
<i>Agromyza canadensis</i>				
NG, NO	<i>Cynoglossum officinale</i>	L Jun	L Jul	2
<i>Agromyza isolata</i>				
NO, NS	<i>Populus grandidentata</i>	M Sep	E Oct, wintered	10
<i>Agromyza</i> sp. prob. <i>potentillae</i>	<i>Potentilla norvegica</i>	M Sep	0	9
<i>Amauromyza</i> sp. prob. <i>flavifrons</i>	<i>Silene latifolia</i>	L Jun	0	43, 48
<i>Amauromyza flavifrons</i>				
NO	<i>Silene latifolia</i>	L Sep	wintered	8, 42, 46, 47
<i>Cerodontha</i> sp. poss. <i>morosa</i>	<i>Carex</i> sp.	L Jun	E-M Jul	1, 41, 57, 78
<i>Liriomyza brassicae</i>	<i>Cakile edentula</i>	M Aug	L Aug-E Sep	39
<i>Liriomyza eupatorii</i>				
NO	<i>Solidago</i> sp.	M Jun	L Jun	
<i>Liriomyza fricki</i>				
NO, NS	<i>Lathyrus japonicus</i>	M Jun	L Jun	40
<i>Liriomyza fricki</i>	<i>Lathyrus japonicus</i>	L Sep	E Oct & wintered	13
<i>Liriomyza lathyri</i>	<i>Lathyrus japonicus</i>	M Aug-L Sep	wintered	3, 4, 74
NO, NS				
<i>Liriomyza</i> sp. prob. <i>robiniae</i>	<i>Robinia pseudoacacia</i>	E Jun	0	
<i>Nemorimyza posticata</i>	<i>Solidago</i> sp.	M Jul	E Aug	14
<i>Nemorimyza posticata</i>	<i>Solidago</i> sp.	M Sep	wintered	
<i>Phytomyza loewii</i>	<i>Clematis virginiana</i>	L Sep	wintered	6, 49
NO, NS				
<i>Phytomyza</i> sp. prob. <i>plantaginis</i>	<i>Plantago major</i>	M Jul	0	7
Anthomyiidae				
<i>Chirosia spinosissima</i>	<i>Pteridium aquilinum</i>	M Jul	wintered	33, 79
FH				
<i>Chirosia</i> sp.	<i>Pteridium aquilinum</i>	M Sep	0	34
<i>Pegomya rumicifoliae</i>	<i>Rumex obtusifolius</i>	E Jun	L Jun	
HYMENOPTERA				
Tenthredinidae				
<i>Fenella nigrita</i>	<i>Potentilla norvegica</i>	M Sep	E Oct	
NS				
<i>Heterarthrus nemoratus</i>	<i>Betula papyrifera</i>	M Sep	wintered	
NO				
<i>Metallus</i> sp. prob. <i>capitalis</i>	<i>Rubus strigosus</i>	E Oct	0	
<i>Metallus</i> sp. prob. <i>rohweri</i>	<i>Rubus canadensis</i>	M Sep	0	
<i>Metallus</i> sp. prob. <i>rohweri</i>	<i>Rubus flagellaris</i>	L Sep	0	
<i>Metallus</i> sp. prob. <i>rohweri</i>	<i>Rubus parviflorus</i>	M Sep	0	
<i>Nefusa</i> sp. prob. <i>ambigua</i>	<i>Viola</i> sp.	M Sep	0	
<i>Profenusa</i> sp. prob. <i>alumna</i>	<i>Quercus rubra</i>	M Sep	0	
<i>Profenusa</i> sp. prob. <i>thomsoni</i>	<i>Betula papyrifera</i>	M Aug-M Sep	0	
LEPIDOPTERA				
Argyresthiidae				
<i>Argyresthia thuiella</i>	<i>Thuja occidentalis</i>	M Jun	L Jun	63, 67
Bucculatricidae				
<i>Bucculatrix canadensisella</i>	<i>Betula papyrifera</i>	M-L Sep	wintered	32, 56
<i>Bucculatrix packardella</i>	<i>Quercus rubra</i>	M Sep	wintered	

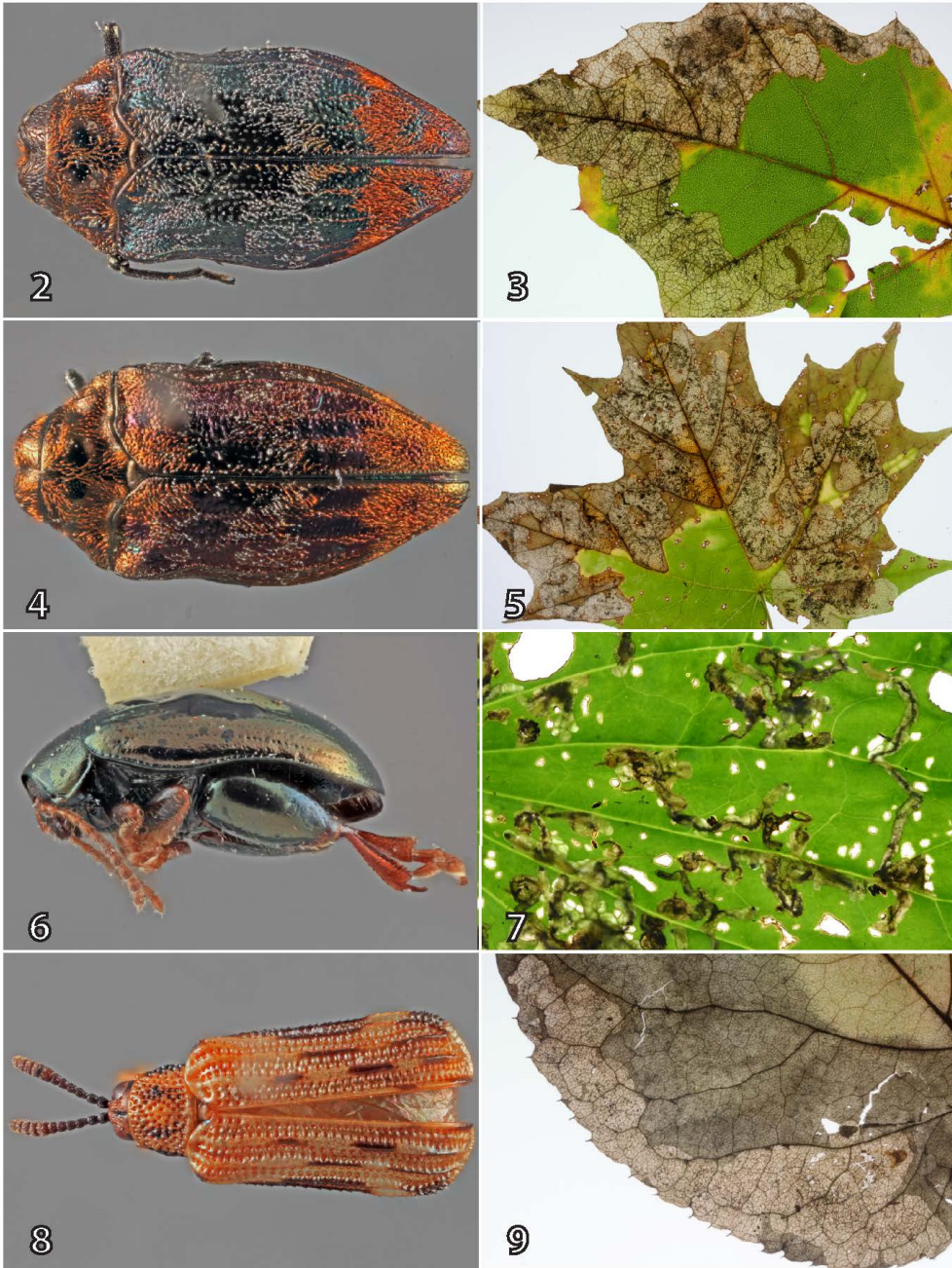
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Table 2. Continued.

Leaf Miner	Larval Host	Recovery Period	Emergence Period	Parasitoid Number(s)
Coleophoridae				
<i>Coleophora pruniella</i>	<i>Crataegus</i> sp.	E Jun	L Jun	
Eriocraniidae				
<i>Eriocrania</i> s. sp. prob. <i>semipurpurella</i>	<i>Betula alleghaniensis</i>	0	0	
<i>Eriocrania</i> s. sp. prob. <i>semipurpurella</i>	<i>Betula papyrifera</i>	E Jun	0	
Gelechiidae				
<i>Scrobipalpula manierreorum</i>	<i>Eurybia macrophylla</i>	M Aug-M Sep	wintered	31, 75.
<i>Scrobipalpula sacculicola</i>	<i>Solidago</i> sp.	M Sep	wintered	
Gracillariidae				
<i>Acrocercops astericola</i>				
NS	<i>Eurybia macrophylla</i>	M-L Sep	wintered	5, 22, 60
<i>Cameraria aceriella</i>	<i>Acer saccharum</i>	M-L Sep	wintered	19, 23
<i>Cameraria bethunella</i>				
NO	<i>Quercus rubra</i>	M Sep-E Oct	wintered	
<i>Cameraria betulivora</i>				
NO	<i>Betula papyrifera</i>	M Sep-E Oct	wintered	
<i>Cameraria corylisella</i>				
NO, NS	<i>Corylus cornuta</i>	M Sep	wintered	61
<i>Cameraria fletcherella</i>	<i>Quercus rubra</i>	M Sep	wintered	
NS				
<i>Cameraria lentella</i>				
NO	<i>Ostrya virginiana</i>	M Jul	E Aug	24
<i>Cameraria lentella</i>	<i>Ostrya virginiana</i>	L Sep	Wintered	15, 20 25, 44
<i>Cameraria ostryarella</i>	<i>Ostrya virginiana</i>	M-L Sep	wintered	26, 38
<i>Cameraria</i> prob. <i>ostryarella</i>	<i>Betula alleghaniensis</i>	M Sep	0	35, 62, 68
<i>Cameraria saccharella</i>				
NO	<i>Acer saccharum</i>	E Aug	wintered	
<i>Gracillaria syringella</i>	<i>Syringa vulgaris</i>	L Jun	M-L Jul	
<i>Gracillaria syringella</i>	<i>Syringa vulgaris</i>	M Aug	M Sep	
<i>Leucanthiza dircella</i>	<i>Dirca palustris</i>	M-L Sep	wintered	45, 51, 58, 66
<i>Macrosaccus robinielli</i>	<i>Robinia pseudoacacia</i>	M Aug- L Sep	L Aug-E Oct	18, 29, 55, 65, 70, 73
<i>Micurapteryx occulta</i>	<i>Lathyrus japonicus</i>	M-L Jun	M Jun-E Jul	
NO				
<i>Micurapteryx occulta</i>	<i>Lathyrus japonicus</i>	M Aug-L Sep	E Sep-M Oct	76
<i>Parectopa</i> sp. prob. <i>robinielli</i>	<i>Robinia pseudoacacia</i>	M Aug	0	
<i>Parornix conspicuella</i>	<i>Betula papyrifera</i>	L Sep	wintered	64
NS				
<i>Phyllocnistis populiella</i>	<i>Populus alba</i>	L Jun-M Jul	L Jul	59
<i>Phyllocnistis populiella</i>	<i>Populus tremuloides</i>	M Jul-M Aug	L Jul-L Aug	52
<i>Phyllocnistis populiella</i>	<i>Populus balsamifera</i>	M Jul-M Aug	L Jul-M Aug	
<i>Phyllonorycter alnicolella</i>	<i>Alnus viridis</i>	L Sep	After winter	
NO, NS				
<i>Phyllonorycter apparella</i>	<i>Populus tremuloides</i>	M Aug	L Aug	21, 27, 53
<i>Phyllonorycter auronitens</i>	<i>Alnus incana</i>	L Sep	wintered	72
NO				
<i>Phyllonorycter basistrigella</i>	<i>Quercus rubra</i>	L Sep-E Oct	wintered	37
<i>Phyllonorycter clemensella</i>	<i>Acer saccharum</i>	M-L Sep	wintered	28, 69
<i>Phyllonorycter ledella</i>	<i>Rhododendron groenlandicum</i>	E May	L May-E Jun	12
NO, NS				
<i>Phyllonorycter lucetiella</i>	<i>Tilia americana</i>	M-L Sep	wintered	36
<i>Phyllonorycter lucidicostella</i>	<i>Acer saccharum</i>	M-L Sep	wintered	77
<i>Phyllonorycter martiella</i>	<i>Betula papyrifera</i>	M Sep	wintered	17
NS				
<i>Phyllonorycter nipigon</i>	<i>Populus balsamifera</i>	M Aug	L Aug	54
<i>Phyllonorycter ostryaefoliella</i>				
NO	<i>Ostrya virginiana</i>	L Sep	wintered	30, 50
<i>Phyllonorycter salicifoliella</i>	<i>Salix</i> sp.	M Aug	L Aug-E Sep	16
<i>Protolithocolletis lathyri</i>	<i>Lathyrus japonicus</i>	L Aug-M Sep	E-L Sep	71
Nepticulidae				
<i>Glaucolepis saccharella</i>				
NO	<i>Acer saccharum</i>	M Sep	wintered	
<i>Stigmella</i> sp. prob. <i>macrocarpae</i>	<i>Quercus rubra</i>	M Sep	0	11
<i>Stigmella quercipulchella</i>				
NO	<i>Quercus rubra</i>	L Sep	wintered	
Tischeriidae				
<i>Coptotriche citrinipennella</i>	<i>Quercus rubra</i>	L Sep	wintered	

Table 3. Hymenopteran parasitoids reared from leaf miners collected at The Huron Mountain Club in upper Michigan. Emergence periods: E (early) = 1st-10th of month; M (mid) = 11th-20th of month; L (late) = 21st-end of month. Recv. = Recovery period. Emerg. = Emergence period.

Parasitoid	Hosts	Recv.	Emerg.
BRACONIDAE			
<i>Chorebus (Stiphrocera)</i> sp. poss. <i>pelion</i> (Nixon)**	<i>Cerodontha</i> sp. poss. <i>morosa</i>	L Jun	wintered
<i>Chorebus (Stiphrocera)</i> sp. poss. <i>perkinsi</i> (Nixon)**	<i>Agromyza canadensis</i>	L Jun	L Jul & wintered
<i>Chorebus</i> sp. 3	<i>Lirionomyza lathyri</i> *	M Aug	E Sep
<i>Chorebus</i> sp. 3	<i>Lirionomyza lathyri</i> *	M Sep	wintered
<i>Colastes</i> sp. 1	<i>Acrocercops astericola</i> *	L Sep	wintered
<i>Dacnusa (Pachysenca)</i> sp. poss. <i>discolor</i> (Förster)**	<i>Phytomyza locvii</i>	L Sep	M Oct
<i>Dapsilarthra (Dapsilarthra) rufiventris</i> (Nees)**	<i>Phytomyza</i> sp. prob. <i>plantaginis</i>	M Jul	L Jul
<i>Dapsilarthra (Dapsilarthra) rufiventris</i> (Nees)**	<i>Amauromyza flavifrons</i>	L Sep	wintered
<i>Dapsilarthra</i> sp. indet.	<i>Agromyza</i> sp. prob. <i>potentillae</i>	M Sep	wintered
<i>Exotela cyclogaster</i> Förster**	<i>Agromyza isolata</i>	M Sep	M Oct
<i>Gnamptodon nepticulae</i> (Rohwer)	<i>Stigmella</i> sp. prob. <i>macrocarpae</i>	M Sep	wintered
<i>Mirax texana</i> Muesebeck	<i>Phyllonorycter ledella</i>	E May	E Jun
<i>Opius</i> sp. 1	<i>Lirionomyza fricki</i> **	L Sep	wintered
<i>Opius</i> sp. 2	<i>Nemorimyza posticata</i>	M Jul	E Aug
<i>Pholetesor</i> sp. 1	<i>Cameraria lentella</i> *	L Sep	wintered
<i>Pholetesor</i> sp. 1	<i>Phyllonorycter salicifoliella</i>	M Aug	L Aug
<i>Pholetesor</i> sp. 1	<i>Phyllonorycter martiella</i> *	M Sep	wintered
<i>Pholetesor</i> sp. 2	<i>Macrosaccus robinella</i>	L Sep	wintered
<i>Pholetesor</i> sp. 2	<i>Cameraria aceriella</i>	L Sep	wintered
<i>Pholetesor</i> sp. 3	<i>Cameraria lentella</i>	L Sep	wintered
<i>Pholetesor</i> (male)	<i>Phyllonorycter apparella</i>	M Aug	L Aug
<i>Pholetesor</i> (male)	<i>Acrocercops astericola</i>	L Sep	wintered
<i>Pholetesor</i> (male)	<i>Cameraria aceriella</i>	L Sep	wintered
<i>Pholetesor</i> (male)	<i>Cameraria lentella</i>	M Jul	E Aug
<i>Pholetesor</i> (male)	<i>Cameraria lentella</i>	L Sep	wintered
<i>Pholetesor</i> (male)	<i>Cameraria ostryarella</i>	M Sep	wintered
<i>Pholetesor</i> (male)	<i>Phyllonorycter apparella</i>	M Aug	L Aug
<i>Pholetesor</i> (male)	<i>Macrosaccus robinella</i>	L Sep	wintered
<i>Rhyssipolis decorator</i> (Haliday)	<i>Phyllonorycter ostryaeoliella</i>	L Sep	wintered
<i>Schoenitandella minuta</i> (Cresson)	<i>Scrobipalpula manierreorum</i>	L Sep	wintered
<i>Stiropius bucculatricis</i> (Ashmead)	<i>Bucculatrix canadensisella</i>	L Aug	wintered
<i>Uteites (Uteites) parvifossa</i> (Fischer)	<i>Chirosia spinosissima</i> *	M Sep	wintered
<i>Uteites (Uteites) parvifossa</i> (Fischer)	<i>Chirosia</i> sp.*	M Jul	E Aug
ENCYRTIDAE			
<i>Ageniaspis bicoloripes</i> (Girault)	<i>Cameraria ostryarella</i> *	M Sep	wintered
<i>Ageniaspis bicoloripes</i> (Girault)	<i>Phyllonorycter lucaetiella</i> *	M Sep	wintered
EULOPHIDAE			
<i>Achrysocharoides reticulatus</i> Yoshimoto	<i>Phyllonorycter basistrigella</i>	L Sep	wintered
<i>Baryscapus</i> sp.	<i>Cameraria ostryarella</i>	M Sep	wintered



Figures 2–9. **Fig. 2.** *Brachys aerosus*: adult. **Fig. 3.** *Brachys aerosus*: nearly completed mine with larva. **Fig. 4.** *Brachys aeruginosus*: adult. **Fig. 5.** *Brachys aeruginosus*: nearly completed mine with larva. **Fig. 6.** *Dibolia borealis*: adult. **Fig. 7.** *Dibolia borealis*: several mines, each with a single larva. **Fig. 8.** *Sumitrosis inaequalis*: adult. **Fig. 9.** *Sumitrosis inaequalis*: completed and vacated mine.

larva is dark yellow with a dark brown head and prothorax. It exits its mine prior to pupating. These observations agree with those of Reed (1927). Adults were recovered on host leaves during early June only.

Sumitrosis inaequalis (Weber) (Fig. 8, 9). **Specimen data:** River Styx 46°50.627N 87°1.300W, 3 larvae 14 Jul 2003, 2 adults 01 Aug 2003, Lot 1411. **Distribution:** CANADA: AL, BC, MB, NB, NS, ON, SK; U.S.A.: AL, AZ, CA, CO, CT, DE, FL, GA, IA, IL, IN, KS, KY, LA, ME, MD, MA, MI, MN, MO, MT, NE, NH, NJ, NY, NC, OH, OK, PA, RI, SC, TN, TX, UT, VT, VA, WI, WY (Staines 2006). **Larval hosts:** *Ambrosia artemisiifolia* L., *Aster divaricatus* L., *A. novae-angliae* (L.) Nesom, *A. sagittifolius* Willd., *Baccharis* sp., *Eupatorium ageratooides* L. f., *E. maculatum* L., *E. perfoliatum* L., *E. rugosum* Houtt., *E. urticifolium* L. f., *Eurybia divaricata* (L.) Nesom, *Euthamia graminifolia* (L.) Nutt., *Helianthus hirsutus* Raf., *Polymnia* sp., *Rudbeckia triloba* L., *Solidago canadensis* L., *S. gigantea* Ait., *S. patula* Muhl. ex Willd., *S. ulmifolia* Muhl. ex Willd., *Symphotrichum anomalum* (Engelm.) Nesom, *Vernonia noveboracensis* (L.) Michx., *Zexmenia* sp. (Staines 2012); *Eurybia* (*Aster*) *macrophylla* (L.) Cass. (identified in this survey). **Parasitoids:** **Chalcididae:** *Conura albifrons* Walsh (Noyes 2018); **Ichneumonidae:** *Scambus hispae* (Harris), *Tromatobia ovivora* (Boheman) (Yu et al. 2012). **Remarks:** In this survey one to two mines occur per leaf but only a single larva in each. The wide track mine along the leaf margin is mainly on the upper surface. Frass is dispersed as black particles. Pupation occurs within its mine. This agrees with observations of Eiseman (2014) of *S. inaequalis* on *E. divaricata*.

DIPTERA

Agromyzidae

Agromyza canadensis Malloch (Fig. 10). **Specimen data:** Stone House 46°50.627N 87°51.300W, 10 larvae 30 Jun 2000, 1♂ 30 Jun 2000, Lot 1024. **Distribution:** CANADA: AL, ON, YT; U.S.A.: CA (Frick 1959, Sehgal 1971, Spencer 1981). **Larval hosts:** *Mertensia paniculata* (Aiton) G. Don (Sehgal), *Cynoglossum officinale* L. (identified in this survey). **Parasitoids:** **Braconidae:** *Chorebus* (*Stiphrocera*) sp. poss. *perkinsi* (Nixon) (identified in this survey). **Remarks:** The upper surface mine is a wide track from the leaf base toward the apex. It usually remains on one side of the main vein. In wider leaves this mine is a meandering wide track. A herringbone feeding pattern is clearly visible. Frass is composed of irregular black particles in a loose wide central trail. One to two mines per

leaf were observed with one to two larvae per mine. Larvae were nearly fully mature when recovered, exiting the upper leaf surface to pupate. Spencer (1969) thought empty mines in *C. officinale*, recovered in Ontario, were of this species. Sehgal (1971) reported rearing *A. canadensis* from blotch mines in leaves of *M. paniculata*. The larva exiting its mine prior to pupating agrees with Sehgal's brief notes. *Chorebus perkinsi* is currently known only from the Palearctic Region. It has been reported primarily from the United Kingdom east to Azerbaijan but has also been reported from Primorsky Krai, Russia (Yu et al. 2012). If verified the specimens in this research would be the first record of this species for the New World and the first braconid reported from *A. canadensis*.

Agromyza isolata Malloch (Fig. 11). **Specimen data:** Main and Flat Rock roads 46°53.651N 87°55.171W, 10 larvae 18 Sep 2007, 5 adults 07–08 Oct 2007 and 1♂ after winter, Lot 1837. **Distribution:** U.S.A.: CA, CO, KS, MN, PA, WA (Spencer and Steyskal 1986). **Larval hosts:** *Populus* spp., *Salix* spp. (Spencer and Steyskal 1986). *Populus grandidentata* Michx. (identified in this survey). **Parasitoids:** **Braconidae:** *Opius isolatae* Fischer (Yu et al. 2012). **Braconidae:** *Exotela cyclogaster* Förster (identified in this survey). **Remarks:** There are two to nine mines per leaf and one to three larvae per mine. The mine is an upper surface wide meandering track with the initial portion darkened. Frass is composed of black irregular particles in a distinct central trail. The larva exits the upper leaf surface prior to pupating. Prior to this research *E. cyclogaster* was known only from the Palearctic Region, ranging in the west from the United Kingdom east to Azerbaijan and in the east from Sakhalin Oblast, Russia to the Korean Peninsula (Yu et al. 2012). The specimens in this research are the first records of this species for the New World and as a parasitoid of *A. isolata*.

Agromyza sp. prob. *potentillae* (Kaltenbach) (Fig. 12). **Specimen data:** Loop Rd. 46°50.627N 87°51.300W, 6 larvae, 20 Sep 2007 0 adults, Lot 1845. **Distribution:** CANADA: Widespread; U.S.A.: CA, CO, UT (Spencer and Steyskal 1986); CANADA: BC, ON, QC (as *A. spiraeae*) (Spencer 1969). **Larval hosts:** *Potentilla gracilis* Douglas ex Hook. (Spencer and Steyskal 1986). *Potentilla norvegica* L. (identified in this survey). **Parasitoids:** **Eulophidae:** *Pnigalio soemius* (Walker); **Pteromalidae:** *Stictomischus groschkei* Delucchi (Noyes 2018); **Braconidae:** *Chorebus* (*Stiphrocera*) *bres* (Nixon), *Chorebus* (*Stiphrocera*) *credne* (Nixon), *Chorebus* (*Stiphrocera*) *deione* (Nixon), *Chorebus* (*Stiphrocera*) *eros* (Nixon), *Dacnusa* (*Pachysema*) *evadne* Nixon,

Dacnusa (Pachysema) laeta (Nixon), *Dacnusa (Dacnusa) maculipes* Thompson, *Dapsilarthra (Heterolexis) balteata* (Thompson), *Dapsilarthra (Heterolexis) okazakii* Takada and Imura, *Dapsilarthra (Dapsilarthra) rufiventris* (Nees), *Exotela nowakowskii* Griffiths, *Opius (Opius) agromyzicola* Fischer, *Opius (Nosopoea) cingulatus* Wesmael, *Opius (Misophthora) instabilis* Wesmael, *Opius (Nosopoea) maculipes* Wesmael, *Opius (Opius) pallipes* Wesmael, *Opius (Agnopius) similis* Szépligeti, *Opius (Allophlebus) singularis* Wesmael (Yu et al. 2012). **Braconidae:** *Dapsilarthra* sp. indet. (identified in this survey). **Remarks:** There is only one mine per leaflet and one larva per mine. The mine is located on the upper surface, initially serpentine but expanding into an elongate blotch. Frass is black and scattered. Prior to pupating the larva exits the upper leaflet surface. The only other known North American agromyzid blotch miner of *Potentilla* is *Agromyza sulfuriceps* Strobl. Its frass is arranged in two distinct rows rather than scattered as in *A. potentillae*.

Amauromyza flavifrons (Meigen) (Fig. 13, 14). **Specimen data:** Lower Dam 46°48.720N 87°48.772W, 20 larvae 24 Sep 2001, 1♂, 2♀ after wintering, Lot 1242; same location, 17 larvae 23 Sep 2002, 1♀ after wintering, Lot 1353; Ives Lk. Rd. 46°50.475N, 87°50.581W, 2 larvae 26 Jun 2002, 0 adults, Lot 1296; same site, 2 larvae 26 Jun 2002, 0 adults, Lot 1297. **Distribution:** CANADA: ON (Spencer 1969); U.S.A.: DE, OH, PA, WI (Spencer and Steyskal 1986). **Larval hosts:** *Dianthus* (Spencer 1969), *Lychnis alba* Miller, *Saponaria officinalis* L. (Spencer and Steyskal 1986). *Silene latifolia* Poir. (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis amyite* (Walker), *Chrysocharis giraulti* Yoshimoto, *Chrysocharis oscinidis* Ashmead, *Chrysocharis pentheus* (Walker), *Chrysocharis pubicornis* (Zetterstedt), *Chrysocharis viridis* (Nees), *Diglyphus chabrias* (Walker), *Diglyphus isaea* (Walker) (Noyes 2018); **Braconidae:** *Bracon (Glabrobracon) atrator* Nees, *Bracon (Glabrobracon) parvulus* (Wesmael), *Chorebus (Stiphrocera) lateralis* (Haliday), *Chorebus (Stiphrocera) trilobomyzae* Griffiths, *Dacnusa (Dacnusa) maculipes* Thompson, *Dapsilarthra (Dapsilarthra) rufiventris* (Nees), *Dapsilarthra (Dapsilarthra) sylvia* (Haliday), *Opius (Nosopaeopiis) ochrogaster* Wesmael, *Opius (Cryptonastes) tersus* (Förster), *Phaedrotoma variegata* (Szépligeti) (Yu et al. 2012). **Eulophidae:** *Chrysocharis crassiscapus* (Thompson), *Chrysocharis giraulti*, *Chrysocharis oscinidis*, *Chrysocharis* sp. (♂), *Chrysocharis* sp. (♀); **Braconidae:** *Dapsilarthra (Dapsilarthra) rufiventris* (identified in this survey). **Remarks:** The initial linear portion of this upper surface mine is encom-

passed by the later developed blotch. The larva is a solitary feeder. Frass consists of irregular black particles scattered through the mine. The larva crosses the main vein while feeding and exits the upper leaf surface prior to pupating. The fully developed last instar larva is golden yellow. The Holarctic *Chrysocharis crassiscapus* is reported from *A. flavifrons* for the first time. It was previously reported from *Amauromyza* sp. by Hansson (1987).

Cerodontha sp. poss. *morosa* (Meigen) (Fig. 15). **Specimen data:** Mountain Stream Falls 46°52.188N 87°53.685W, 1 larva, 37 puparia 28 Jun 2000, 1 adult 08 Jul and 1♂ 11 Jul 2000, Lot 1022. **Distribution:** U.S.A.: CA, MT (Spencer and Steyskal 1986). **Larval hosts:** *Carex* (Spencer and Steyskal 1986). *Carex* sp. (identified in this survey). **Parasitoids:** **Braconidae:** *Chorebus (Stiphrocera) pelion* (Nixon), *Chorebus (Chorebus) siniffa* (Nixon), *Opius (Agnopius) similis* (Yu et al. 2012). **Eulophidae:** *Chrysocharis beckeri* Yoshimoto, *Pediobius albipes* (Provancher); **Pteromalidae:** *Halticoptera* sp. (identified in this survey); **Braconidae:** *Chorebus (Stiphrocera)* sp. poss. *pelion* (identified in this survey). **Remarks:** There are one to four mines per leaf with one larva per mine. The completed upper surface mine is a longitudinal track, crossing larger veins only when the larva is nearly fully developed. Frass is not apparent. The larva pupates within its mine. Host, mine, shape, location, and pupation site are consistent with the habits described for *C. morosa* in Spencer and Steyskal (1986). The species could not be identified, “Apex of distiphallus absent,” Boucher, personal communication. *Chorebus pelion* is currently known only from the Palearctic Region. It has been reported primarily from Sweden south to Germany and east to Ukraine but has also been reported from Kamchatka Krai, Russia (Yu et al. 2012). If verified the specimen in this research would be the first record of *C. pelion* for the New World. *Chrysocharis beckeri*, *P. albipes*, and *Halticoptera* sp. are all new host records for *C. morosa*.

Liriomyza brassicae (Riley) (Fig. 16, 17). **Specimen data:** Conway Bay 46°53.101N 87°48.705W, 11 larvae 19 Aug 2004, 2♀ 31 Aug–03 Sep 2004, Lot 1521. **Distribution:** CANADA: “Semi-cosmopolitan.” U.S.A.: “Widespread, probably present in most States” (Spencer and Steyskal 1986). **Larval hosts:** Primarily Brassicaceae, including host plants in the following genera: *Barbarea*, *Brassica*, *Cakile*, *Capparis*, *Cheiranthus*, *Cleome*, *Gynandropsis*, *Hirschfeldia*, *Isatis*, *Lepidium*, *Matthiola*, *Moricandia*, *Nasturtium*, *Raphanus*, *Rorippa*, *Sinapis*, *Tropaeolum* (Spencer and Steyskal 1986, Spencer 1990). *Cakile edentula* (Bigelow)



Figures 10–17. **Fig. 10.** *Agromyza canadensis*: vacated mine showing arced feeding pattern. **Fig. 11.** *Agromyza isolata*: 2 coalesced and vacated mines. **Fig. 12.** *Agromyza* sp. prob. *potentillae*: 2 leaflets, each with a single mine, 1 with an active larva. **Fig. 13.** *Amauromyza flavifrons*: adult. **Fig. 14.** *Amauromyza flavifrons*: completed and vacated mine. **Fig. 15.** *Cerodontha* sp. poss. *morosa*: completed and vacated mine. **Fig. 16.** *Liriomyza brassicae*: adult. **Fig. 17.** *Liriomyza brassicae*: nearly completed mine with larva at mine widening.

Hooker (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis* sp., *Chrysocharis vonones* (Walker), *Closterocerus mirabilis* Edwards and La Salle, *Diaulinopsis callichroma* Crawford, *Diglyphus* sp. Walker, *Meruacesa liriomyzae* (Boucek), *Pnigalio* sp. **Pteromalidae:** *Pachyneuron* sp., *Trigonogastrella parasitica* Girault (Noyes 2018); **Braconidae:** *Opius* (*Pendopius*) *volaticus* Fischer, *Phaedrotoma scabriventris* (Nixon) (Yu et al. 2012). **Eulophidae:** *Chrysocharis ainsliei* Crawford (identified in this survey). **Remarks:** The mine is located on both leaf surfaces though more apparent from the upper side. It is linear gradually widening and frequently traversing much of the leaf length. Black frass is placed in an intermittent trail along one side of the mine. The larva exits the upper leaf surface prior to pupating. *Chrysocharis ainsliei* is reported for the first time from *L. brassicae*. Its known dipteran host range includes six genera of Agromyzidae, including 10 species of *Liriomyza*. It has also been recorded from four families of microlepidoptera, one species each (Noyes 2018).

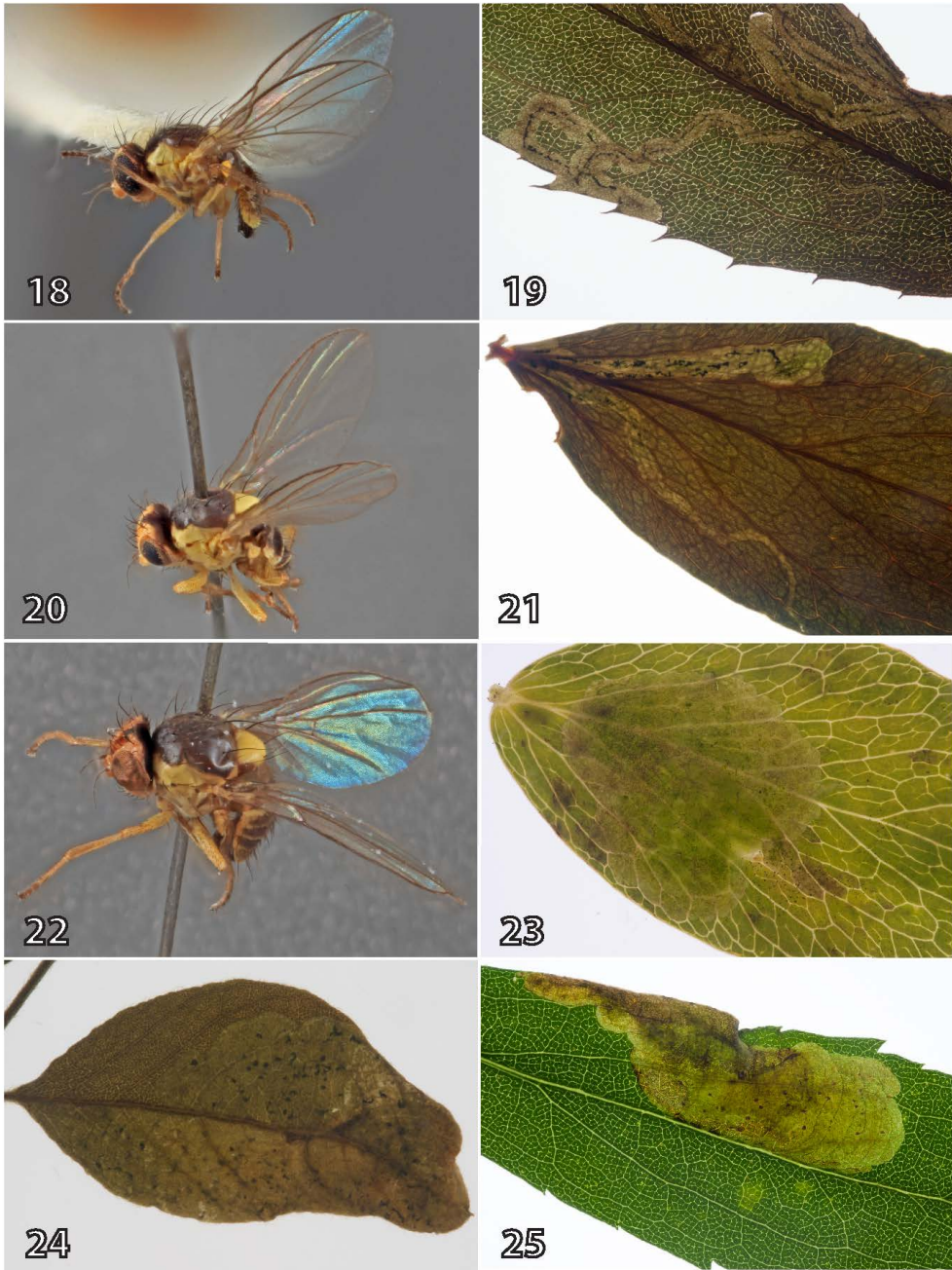
Liriomyza eupatorii (Kalthenbach) (Fig. 18, 19). **Specimen data:** Lower Dam 46°48.720N 87°48.772W, 3 larvae, 1 puparium 13 Jun 2001, 1♂, 1♀ 24 Jun 2001, Lot 1129. **Distribution:** EUROPE. CANADA: AB; U.S.A.: CA, GA, MS, NC, SC, TN, VA, WA (Sehgal 1971, Spencer and Steyskal 1986). **Larval hosts:** *Symphotrichum* (*Aster*) *chilensis* (Nees) G. L. Nesom, *Eupatorium*, *Helianthus*, *Lapsana* (misspelling, possibly *Lapsana*, an Asteraceae), *Solidago* sp. (Sehgal 1971, Spencer and Steyskal 1986). *Solidago* sp. (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis liriomyzae* Delucchi, *Chrysocharis pentheus*, *Pnigalio soemius*; **Pteromalidae:** *Miscogaster* sp., *Miscogaster maculata* Walker, *Sphaeripalpus fuscipes* (Walker) (Noyes 2018); **Braconidae:** *Atormus victus* (Haliday), *Opius* (*Allophlebus*) *singularis* (Yu et al. 2012). **Remarks:** Four or more upper surface mines may occur per leaf with a single larva in each mine. Spencer and Steyskal (1986) indicated that the mine in *Solidago* from Mississippi begins as a spiral. Mines in this rearing did not exhibit that feature though a half circle was formed initially. Frass particles are placed in a central broken line. The larva is yellow and exits its mine from either the upper or lower surface prior to pupating.

Liriomyza fricki Spencer (Fig. 20, 21). **Specimen data:** Salmon Trout Bay 46°51.870N 87°46.435W, 4 larvae 11 Jun 2001, 1♂ 22 Jun 2001, Lot 1126; Conway Bay 46°53.101N 87°48.705W, 4 larvae 23 Sep 2002, 1♂ 06 Oct 2002 and after wintering, Lot 1348. **Distribution:** CANADA: AB;

U.S.A.: CA, WA, WI (Sehgal 1971, Spencer and Steyskal 1986). **Larval hosts:** *Lathyrus ochroleucus* Hook., *Medicago*, *Melilotus* [sic] (probably *Melilotus*), *Trifolium repens* L., *Vicia americana* Muhl., *Vigna* (Sehgal 1971, Spencer and Steyskal 1986). *Lathyrus japonicus* Willd. (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis crassiscapus*, *Chrysocharis oscinidis* (Noyes 2018). **Eulophidae:** *Chrysocharis ainsliei*; **Braconidae:** *Opius* sp. 1 (identified in this survey). **Remarks:** The rather short mine is placed on the upper surface with one to two mines per leaf and a single larva per mine. It is linear with a thin central broken green-black frass trail. Mines from these rearings agree with the description in Spencer and Steyskal (1986). The larva is bright yellow upon exiting the upper leaf surface prior to pupating. The pupa is a dull orange. From these two rearings there are clearly at least two generations per year at HMC. The species of *Opius* reared in this survey is the first braconid reported from *L. fricki*. *Chrysocharis ainsliei* is reported for the first time from *L. fricki* (see notes under Discussion of *L. brassicae*).

Liriomyza lathyri Sehgal (Fig. 22, 23). **Specimen data:** Conway Bay 46°53.101N 87°48.705W, 2 larvae 24 Sep 2002, 1♂ after wintering, Lot 1349; Gillet Landing 46°51.870N 87°46.435W, 7 larvae 16 Aug 2004, 0 adults, Lot 1508; same site, 4 larvae 16 Sep 2006, 0 adults, Lot 1755; same site, 3 larvae 27 Aug 2009, 1♂, 1♀ after winter, Lot 1939. **Distribution:** CANADA: AB; U.S.A.: AR (Spencer and Steyskal 1986). **Larval hosts:** *Lathyrus ochroleucus* (Sehgal 1971); *Lathyrus* sp. (Spencer and Steyskal 1986). *L. japonicus* (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis crassiscapus* (Noyes 2018). **Braconidae:** *Chorebus* sp. 3 (identified in this survey); **Figitidae:** *Banacuniculus strykeri* (holotype). *Banacuniculus strykeri* data were originally published in Buffington (2010). **Remarks:** The upper surface blotch mine is initially linear. One or two mines occur per leaflet with one to four larvae per mine. Frass appears as indistinct scattered green/black spotting. The larva exits the upper mine surface prior to pupating. These observations agree with Sehgal's (1971) notes in his original species description. The species of *Chorebus* reared in this survey is the first braconid reported from *L. lathyri*.

Liriomyza sp. prob. *robiniae* Valley (Fig. 24). **Specimen data:** Ives Road 46°50.475N 87°50.581W, 10 larvae 10 Jun 2004, 0 adults, Lot 1486. **Distribution:** U.S.A.: NY, PA, VA, WV (Valley 1982). **Larval hosts:** *Robinia pseudoacacia* L. (Valley 1982). *Robinia pseudoacacia* (identified in this survey). **Parasitoids:** None reported



Figures 18–25. **Fig. 18.** *Liriomyza eupatorii*: adult. **Fig. 19.** *Liriomyza eupatorii*: a completed and vacated mine on each side of main vein. Arc exit cut visible at mine terminus. **Fig. 20.** *Liriomyza fricki*: adult. **Fig. 21.** *Liriomyza fricki*: completed and vacated mine. **Fig. 22.** *Liriomyza lathyri*: adult. **Fig. 23.** *Liriomyza lathyri*: completed and vacated mine. **Fig. 24.** *Liriomyza* sp. prob. *robiniae*: vacated mine. **Fig. 25.** *Nemorimyza posticata*: vacated mine showing arced feeding lines.

(Yu et al. 2012, Noyes 2018). **Discussion:** The completed mine is a full depth blotch. The frass is scattered irregular-sized black particles. The larva exits its mine at the leaf edge prior to pupating. Though no adults were obtained, this identification is based upon host, early seasonal occurrence of mine, and mining characters described and illustrated as an unknown Agromyziidae by Weaver and Dorsey (1967). Valley (1982) subsequently referred to the mining characters in Weaver and Dorsey (1967) as *L. robiniae* after a conversation of Valley with Weaver. *Liriomyza robiniae* is the only known Agromyziidae leaf miner of *R. pseudoacacia*.

Nemorimyza posticata (Meigen) (Fig. 25). **Specimen data:** Quarry-Fen 46°53.839N 87°53.607W, 11 larvae 18 Jul 2003, 1♀ 07 Aug 2003, Lot 1424; Loop Rd. 46°50.627N 87°51.300W, 8 larvae 20 Sep 2007, 3 adults after winter, Lot 1843. **Distribution:** COSTA RICA, EUROPE, JAPAN, CANADA: AB; U.S.A.: Probably all States (Sehgal 1971, Spencer and Steyskal 1986). **Larval hosts:** *Aster*, *Baccharis*, *Erechtites*, *Solidago* (Spencer and Steyskal 1986). *Solidago* sp. (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis crassiscapus*, *Chrysocharis viridis* (Noyes 2018); **Braconidae:** *Opius* (*Nosopoea*) *ambiguus* Wesmael, *Opius* (*Tobia*) *hoffmanni* Fischer, *Opius* (*Allotypus*) *saevus* Haliday, *Utetes* (*Utetes*) *posticatae* (Fischer) (Yu et al. 2012). **Braconidae:** *Opius* sp. 2 (identified in this survey). **Remarks:** One or two mines occur per leaf, but there is only one larva per mine. Each mine is confined to one side of the main vein. When fully formed the mine is an upper surface elongate blotch with a rounded herringbone feeding pattern evident. Only a few scattered black frass particles are visible. The larva exits the upper leaf surface prior to pupating. From these emergence records there appears to be two generations per year at HMC.

Phytomyza loewii Hendel (Fig. 26, 27). **Specimen data:** Ives Lake Rd. 46°50.475N 87°50.581W, 6 larvae 26 Sep 2002, 1♀ after wintering, Lot 1357. **Distribution:** CANADA. U.S.A.: CA, DC, GA, ID, IN, LA, WA (Spencer and Steyskal 1986). **Larval hosts:** *Clematis* spp., including *C. ligusticifolia* Nutt. and *C. verticillaris* DC. (Spencer and Steyskal 1986). *Clematis virginiana* L. (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Eulophidae:** *Chrysocharis* sp.; **Braconidae:** *Daenusa* (*Pachysema*) sp. poss. *discolor* (Förster) (identified in this survey). **Remarks:** There are one to three mines per leaf but only one larva per mine. The completed mine is linear on the upper surface with frass in a dark trail along one

side of the mine. The larva exits the lower leaf surface prior to pupating. *Dacnusa discolor* is currently known only from the Palearctic Region. It has been reported from Ireland east to Azerbaijan (Yu et al. 2012). If verified the specimens in this research would be the first record of this species for the New World and the first braconid reported from *P. loewii*. *Chrysocharis* sp. is the first record of a chalcidoid reported from *P. loewii*.

Phytomyza sp. prob. *plantaginis* Robineau-Desvoidy (Fig. 28). **Specimen data:** Case residence 46°50.892N 87°49.783W, 1 puparium 17 Jul 2003, 0 adult, Lot 1419. **Distribution:** CANADA: AB, ON, QC (Spencer 1969, Sehgal 1971); U.S.A.: “Widespread through most of United States” (Spencer and Steyskal 1986). **Larval hosts:** *Plantago lanceolata* and *P. major* (Spencer and Steyskal 1986). *Plantago major* (identified in this survey). **Parasitoids:** **Braconidae:** *Chorebus* (*Stiphrocera*) *anasellus* (Stelfox), *Dacnusa* (*Pachysema*) *discolor*, *Dacnusa* (*Dacnusa*) *maculipes*, *Dacnusa* (*Dacnusa*) *plantaginis* Griffiths, *Dacnusa* (*Pachysema*) *sibirica* Telenga, *Dacnusa* (*Pachysema*) *zlobini* Tobias, *Dapsilarthra* (*Dapsilarthra*) *rufiventris*, *Opius* (*Gastrosema*) *oscinidis* (Ashmead), *Phaedrotoma depeculator* Förster, *Phaedrotoma diversa* (Szépligeti), *Phaedrotoma exigua* (Wesmael) (Yu et al. 2012); **Eulophidae:** *Chrysocharis pubicornis*, *Chrysocharis viridis*, *Diglyphus isaea*, *Hemiptarsenus ornatus* (Nees), *Pnigalio pectinicornis* L.; **Pteromalidae:** *Halticoptera aenea* (Walker); **Tetracampidae:** *Epiclerus panyas* (Walker) (Noyes 2018). **Braconidae:** *Dapsilarthra* (*Dapsilarthra*) *rufiventris* (identified in this survey). **Remarks:** The mine is curved and linear with frass placed in a continuous central line. The larva pupates at the mine terminus with pupal spiracles projecting. This host, mine shape, pupation site, and extended pupal spiracles agree with the descriptions in Spencer and Steyskal (1986). The only other Agromyziidae recorded from *Plantago* as a leaf miner is *Liriomyza blechi* Spencer (Spencer and Steyskal 1986). That species feeds primarily on *Ruellia blechum* L. and forms an irregular blotch mine. Prior to this research *D. rufiventris* was known from the Palearctic, Oriental, and Oceanic regions (Yu et al. 2012). The specimen in this research is the first record of this species for the New World.

Anthomyiidae

Chirosia spinosissima (Malloch) (Fig. 29, 30). **Specimen data:** Near Jensen homestead, 46°53.656N 87°53.131W, 7 larvae, 16-17 Jul 2003, 1♂ after wintering, Lot 1417. **Distribution:** CANADA: NB, ON, QC;



Figures 26–33. **Fig. 26.** *Phytomyza loewii*: adult. **Fig. 27.** *Phytomyza loewii*: vacated mine. **Fig. 28.** *Phytomyza* sp. prob. *plantaginis*: vacated mine. **Fig. 29.** *Chirosia spinosissima*: adult. **Fig. 30.** *Chirosia spinosissima*: lower mine surface with external frass trail between adjacent mined pinnae. **Fig. 31.** *Chirosia* species: larva feeding toward base of pinna. **Fig. 32.** *Pegomya rumicifoliae*: adult. **Fig. 33.** *Pegomya rumicifoliae*: single mine with larva.

U.S.A.: MI, NC, WI (Griffiths 2004). **Larval hosts:** None reported in Griffiths (2004). *Pteridium aquilinum* (L.) Kuhn (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Pteromalidae:** *Lamprotatus* sp.; **Braconidae:** *Utetes (Utetes) parvifossa* (Fischer) (identified in this survey). **Remarks:** The full depth mine includes part or an entire frond pinna. The frass is dark green forming a central trail. The larva exits its mine via the lower surface. The recovered larva was nearly mature, and it was apparent the mine size was too small to account for its entire development. The larva likely exited its initial mine and entered another pinna to continue feeding. This is supported by a frass trail on the lower surface between two partially mined pinnae. With only one cut per mine, it is also apparent the larva enters and exits its mine through this single cut. This is the first report of a larval host for this species though adults have been reported in Michigan (Griffiths 2004). Griffiths suggested larvae would be found on ferns. In his concept of the genus, *Chirosia* species are the only known Anthomyiidae with larvae mining *Pteridium*. *Lamprotatus* sp. is the first chalcidoid reported from *C. spinosissima*.

Chirosia sp. (Fig. 31). **Specimen data:** Jensen homestead 46°53.656N 87°53.131W, 1 larva 14 Sep 2006, 0 adult, Lot 1750. **Larval host:** *Pteridium aquilinum* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Braconidae:** *Utetes (Utetes) parvifossa* (identified in this survey). **Remarks:** This single specimen was found at the same site as *C. spinosissima*, which has a similar mine and frass pattern, though occurring later in the season. The larva exited the lower mine surface prior to pupating as does *C. spinosissima*. An issuing adult would likely have emerged after winter as is the case with *C. spinosissima* and would agree with Griffiths (2004) records of *C. spinosissima*. All 16 *Chirosia* species listed by Griffiths (2004) in northeastern North America have one generation per year with adults issuing between April and June. Fifteen of these species have no recorded larval host. The single larval specimen documented here may be *C. spinosissima*, though its two month later appearance, compared with the earlier confirmed rearing, makes one of the other 15 species, without known hosts, possible candidates.

Pegomya rumicifoliae Hockett (Fig. 32, 33). **Specimen data:** Loop Rd. 46°50.627N 87°51.300W, 11 larvae 06 Jun 2006, 7♂, 2♀ 27–28 Jun 2006, Lot 1699. **Distribution:** CANADA: AB, ON, QC; U.S.A.: MA, MI, NJ, JY, RI, WI (Griffiths 1982), ME (Eiseman 2018). **Larval hosts:** *Rumex crispus* L., *R. obtusifolius* L., *R. mexicanus*

Meisn. (Griffiths 1982), *R. britannica* L. (Eiseman 2018). *Rumex obtusifolius* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** There are frequently several mines per leaf, each forming a widening track. Mines eventually coalesce forming a single mine over much of the upper leaf surface. Each initial mine has an opening at its base. Frass, which is composed of irregular black particles, is deposited at the mine center as an intermittent winding trail. Frost (1924) (as *P. calyprata* (Zetterstedt)) and later Eiseman (2018) reported multiple generations per year; only one was observed and reared in this survey.

HYMENOPTERA

Tenthredinidae

Fenella nigrita Westwood (Fig. 34, 35). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 21 larvae 20 Sep 2007, 1♀ 08 Oct 2007, Lot 1846. **Distribution:** EUROPE; CANADA: ON; U.S.A.: CT, ME, MI (Smith 1971). **Larval hosts:** *Potentilla* sp. (Smith 1971). *Potentilla norvegica* (identified in this survey). **Parasitoids:** None reported (Noyes 2018); **Braconidae:** *Colastes (Shawiana) catenator* (Haliday), *Colastes (Xenarcha) lustrator* (Haliday); **Ichneumonidae:** *Hemiteles pygmaeus* Brischke, *Perilissus cingulatus* Brischke, *Perilissus fenellae* Brischke (Yu et al. 2012). **Remarks:** Only one mine was found per leaflet and one larva per mine. The larva feeds ventral side up. The mine is full depth, beginning as a widening track then later broadening into a blotch. Frass is very distinct black particles initially placed in a wide central trail then later scattered in the blotch portion.

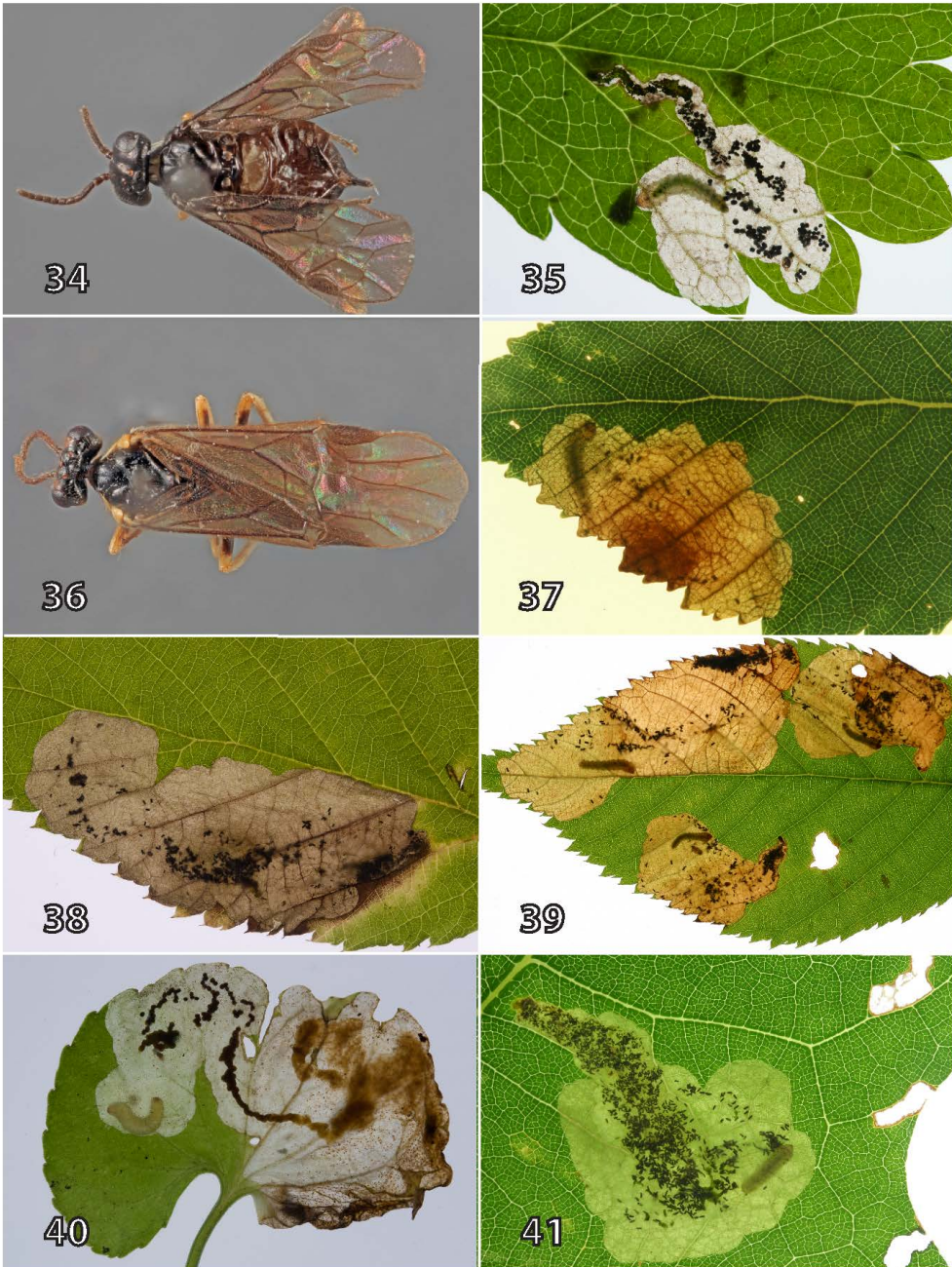
Heterarthrus nemoratus (Fallén) (Fig. 36, 37). **Specimen data:** Conway Bay 46°53.101N 87°48.705W, 14 larvae 19 Aug 2004, 1♀ after winter, Lot 1522; Picnic Point 46°53.056N 87°50.509W, 12 larvae 12 Sep 2005, 0 adults, Lot 1643. **Distribution:** Palearctic Region from Europe to Siberia; CANADA: NL (Smith 1971); AB, BC, NB, NT, NS, ON, QC, SK (Digweed et al. 2009); U.S.A.: MA, NH, NY (Smith 1971); AK, ME (Digweed et al. 2009). **Larval hosts:** *Betula alleghaniensis* Britton, *B. glandulosa* Michx., *B. nana* L., *B. neoalaskana* Sarg., *B. nigra* L., *B. occidentalis* Hook., *B. papyrifera* Marshall, *B. populifolia* Marsh., *B. pumila* L. (Digweed et al. 2009). **Parasitoids:** **Eulophidae:** *Chrysocharis laricinellae* (Ratzeburg), *Chrysocharis nephereus* (Walker), *Chrysocharis nitetis*, *Chrysocharis purpurea* Bukovskii, *Cirrospilus cinctithorax* (Girault), *Cirrospilus flavicinctus* Riley, *Cirrospilus*

pictus (Nees), *Cirrospilus vittatus* Walker, *Closterocerus trifasciatus* Westwood, *Hemiptarsenus fulvicollis* Westwood, *Hemiptarsenus ornatus*, *Minotetrastichus frontalis* (Nees), *Pnigalio cruciatus* (Ratzeburg), *Pnigalio maculipes* (Crawford), *Pnigalio minio* (Walker), *Sympiesis* sp., *Sympiesis gordius* (Walker), *Sympiesis sericeicornis* (Nees); **Torymidae:** *Monodontomerus indiscretus* Gahan; **Trichogrammatidae:** *Trichogramma minutum* Riley (Noyes 2018); **Braconidae:** *Colastes* (*Shawiana*) *phyllotomae* (Muesebeck), *Oncophanes* (*Oncophanes*) *betulae* Muesebeck, *Stiropius bucculatricis* (Ashmead); **Ichneumonidae:** *Agrothereutes abbreviatus iridescens* (Cresson), *Agrypon metallicum* (Norton), *Alophosternum foliicola* Cushman, *Dolophron nemorati* Horstmann, *Dolophron pedella* (Holmgren), *Exochus cuneatus* Townes and Townes, *Exochus pictus xanthopsis* Ashmead, *Gelis obscurus* (Cresson), *Gelis urbanus* (Brues), *Gnathochoris dentifer* (Thomson), *Mastrus laplantei* Mason, *Mesoleius phyllotomae* Cushman, *Scambus foliae* (Cushman), *Scambus hispae* (Yu et al. 2012). **Remarks:** There is only one mine per leaf and a single larva per mine. The mine is a full depth blotch, reddened at its leaf edge origin and lightening inward. Frass is composed of scattered black oblong particles. The dearth of frass and absence of cast larval exuvia imply most was expelled through the slit located in the leaf edge. The larva pupates in its mine by forming a circular cocoon approximately 8 mm in diameter. Both mine and adult agree with the descriptions provided by Digweed et al. (2009).

Metallus sp. prob. *capitalis* (Norton) (Fig. 38). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 3 larvae 04 Oct 2009, 0 adults, Lot 1958. **Distribution:** Probably transcontinental across northern United States and southern Canada. **CANADA:** BC, NB, NL, NS, ON, QC; **U.S.A.:** IA, ID, IL, ME, MA, MI, NH, NY, OR, VT (Eiseman and Smith 2017). **Larval hosts:** *Rubus* sp. (Smith 1971). *Rubus strigosus* Michaux (identified in this survey). **Parasitoids:** **Eulophidae:** *Pnigalio* sp., two undetermined species (Eiseman and Smith 2017). **Remarks:** There is one mine per leaflet and only one larva per mine. This full depth mine is blotch-shaped initiated away from the leaf edge. Black frass particles are concentrated toward the mine center with some scattered. The larva exits the upper leaf surface prior to pupating. *Metallus* is the only genus of Tenthredinidae in North America known to mine *Rubus* (Smith 1971). Only two of the three North American species feed on *Rubus*. Hoebeke and Wheeler, Jr. (2005) reported larva of the third species, *M. bensoni lanceolatus* (Thomson), feeding on *Geum* sp.

Metallus sp. prob. *rohweri* MacGillivray (Fig. 39). **Specimen data:** Howe Lake 46°53.823N 87°57.668W, 11 larvae 25 Sep 2002, 0 adults, Lot 1356; Flat Rock 46°54.520N 87°55.355W, 16 larvae 19 Sep 2003, 0 adults, Lot 1444; Rush Lake Boat House 46°53.209N 87°53.681W, 43+ larvae 14 Sep 2005, 0 adults, Lot 1655. **Distribution:** **CANADA:** NB, NS, ON; **U.S.A.:** CT, DE, FL, IL, ME, MD, MA, MI, MO, NJ, NY, NC, OH, PA, RI, VA (Smith 1971). **Larval hosts:** *Rubus* spp. (Smith 1971); *R. canadensis* L. (Lot 1655), *R. flagellaris* Willd. (Lot 1356), and *R. parviflorus* Nutt. (Lot 1444) (identified in this survey). **Parasitoids:** **Braconidae:** *Colastes* (*Shawiana*) *metalli* (Muesebeck), *Proterops proteroptoides* (Viereck); **Ichneumonidae:** *Campeletis argentifrons* (Cresson), *Endasys praerundiceps* Luhman, *Iseropus coelebs* (Walsh), *Lathrolestes* (*Lathrolestes*) *constrictus* (Provancher), *Lathrolestes* (*Lathrolestes*) *truncatus* (Provancher), *Scambus hispae* (Yu et al. 2012). **Eulophidae:** *Pnigalio maculipes*, *P. minio* (Noyes 2018). **Remarks:** Eggs are imbedded in the leaf and visible from the lower surface. Mines are full depth beginning near a vein as a widening track then later expanding into a swollen blotch that may coalesce with other mines. Five to seven miners occur per leaflet with one to two miners per mine. Frass is both clumped and scattered. The larva usually exits its mine via the lower leaf surface though occasionally from the upper surface. These observations agree with those provided by Daniel (1928) except for the larva exiting its mine primarily from the lower surface. Daniel (1928) described two generations per year in western New York State, but only one generation was observed during this survey. The single generation per year agrees with observations of Eiseman and Smith (2017).

Nefusa sp. prob. *ambigua* (Norton) (Fig. 40). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 3 larvae 20 Sep 2007, 0 adults, Lot 1847. **Distribution:** **CANADA:** NS, QC; **U.S.A.:** AR, IA, IL, KY, MA, MD, MA, MI, MO, NY, OH, PA, TN, TX, WV, VA, WI (Smith and Eiseman 2015). **Larval hosts:** *Viola canadensis* L., *V. palmata* L., *V. pubescens* Ait., *V. sororia* Willd. (Smith and Eiseman 2015). *Viola* sp. (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** Only one mine per leaf and one larva per mine were observed. The mine is full depth. It likely begins at the leaf edge though the early mine area was dried and wrinkled when recovered. The completed mine encompassed much of the leaf. Frass initially appears as a brown smear and later becomes distinct black particles arranged in an intermittent line. The larva exits the



Figures 34–41. **Fig. 34.** *Fenella nigrita*: adult. **Fig. 35.** *Fenella nigrita*: near-mature larva feeding ventral side up. **Fig. 36.** *Heterarthrus nemoratus*: adult. **Fig. 37.** *Heterarthrus nemoratus*: nearly completed mine with feeding larva. **Fig. 38.** *Metallus* sp. prob. *capitalis*: completed mine. **Fig. 39.** *Metallus* sp. prob. *rohweri*: 3 mines on *Rubus canadensis*. **Fig. 40.** *Nefusa* sp. prob. *ambigua*: nearly completed mine with larva. **Fig. 41.** *Profenusa* sp. prob. *alumna*: upper leaf surface with larva feeding, prolegs visible.

lower leaf surface prior to pupating. These observations agree with the brief notes of Shaw (1940) and the more extensive observations of Smith and Eiseman (2015). This is the only species of Tenthredinidae in North America with larvae known to feed in *Viola*.

Profenusa sp. prob. *alumna* (MacGillivray) (Fig. 41). **Specimen data:** Rush Lake Boat House 46°53.209N 87°53.681W, 4 larvae 14 Sep 2006, 0 adults, Lot 1752. **Distribution:** U.S.A.: IL, ME, MD, NY, PA, VA (Smith 1971). **Larval hosts:** *Quercus alba* L., *Q. ilicifolia* Wangenh., *Q. macrocarpa* Michx., *Q. rubra*, *Q. velutina* Lam. (Smith 1971). *Quercus rubra* (identified in this survey). **Parasitoids:** **Ichneumonidae:** *Lathrolestes (Lathrolestes) luteolator* (Gravenhorst), *Lathrolestes (Lathrolestes) platynus* (Davis) (Yu et al. 2012). **Remarks:** One mine per leaf and one larva per mine were observed. The upper surface mine begins as a widening track becoming a blotch. The larva feeds ventral side upward and exits the upper leaf surface prior to pupating. Black frass particles are scattered within its mine though away from the mine perimeter. *Profenusa* is the only genus of Tenthredinidae known to mine *Quercus* leaves. Of the five species in North America, three are miners of *Quercus* leaves.

Profenusa sp. prob. *thomsoni* (Konow) (Fig. 42). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 2 larval skins 27 Sep 2002, 0 adult, Lot 1365; Quarry-Fen 46°53.839N 87°53.607W, 1 larva 17 Sep 2003, 0 adults, Lot 1441; same location, 2 larvae 16 Aug 2004, 0 adults, Lot 1515; Gillet Landing 46°51.870N 87°46.435W, 7 larvae 16 Aug 2004, 0 adults, Lot 1510; Picnic Point 46°53.056N 87°50.509W, 2 vacated mines 12 Sep 2005, Lot 1645; Rush Lake Boat House 46°53.209N 87°53.681W, 2 larvae 14 Sep 2006, 0 adults, Lot 1751. **Distribution:** EUROPE; CANADA: ON, QC; U.S.A.: CT, ME, VT (Smith 1971). **Larval hosts:** *Betula alleghaniensis*, *B. papyrifera*, and *B. populifolia* (Smith 1971). *Betula papyrifera* (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis eurynota* Graham, *Chrysocharis nephereus*, *Chrysocharis nitetis*, *Chrysonotomyia* sp., *Minotetrastichus* sp., *Pnigalio* sp., *Sympiesis* sp., *Zagrammosoma* sp.; **Trichogrammatidae:** *Trichogramma* sp., *Trichogramma aurosum* Sugonjaev and Sorokina (Noyes 2018). **Ichneumonidae:** *Lathrolestes (Lathrolestes) luteolator*, *Lathrolestes (Lathrolestes) soperi* Reshchikov, *Lathrolestes (Lathrolestes) thomsoni* Reshchikov (Yu et al. 2012). **Remarks:** One or two mines may occupy a leaf but only a single larva per mine. The upper surface mine begins as a widening track and later becomes a blotch. Frass is initially clumped forming a broken

trail then later scattered. The larva exits the upper leaf surface at or near the mine margin prior to pupating. Mines of reared lots easily key to *P. thomsoni* in Digweed et al. (2009) who include all known species in Canada.

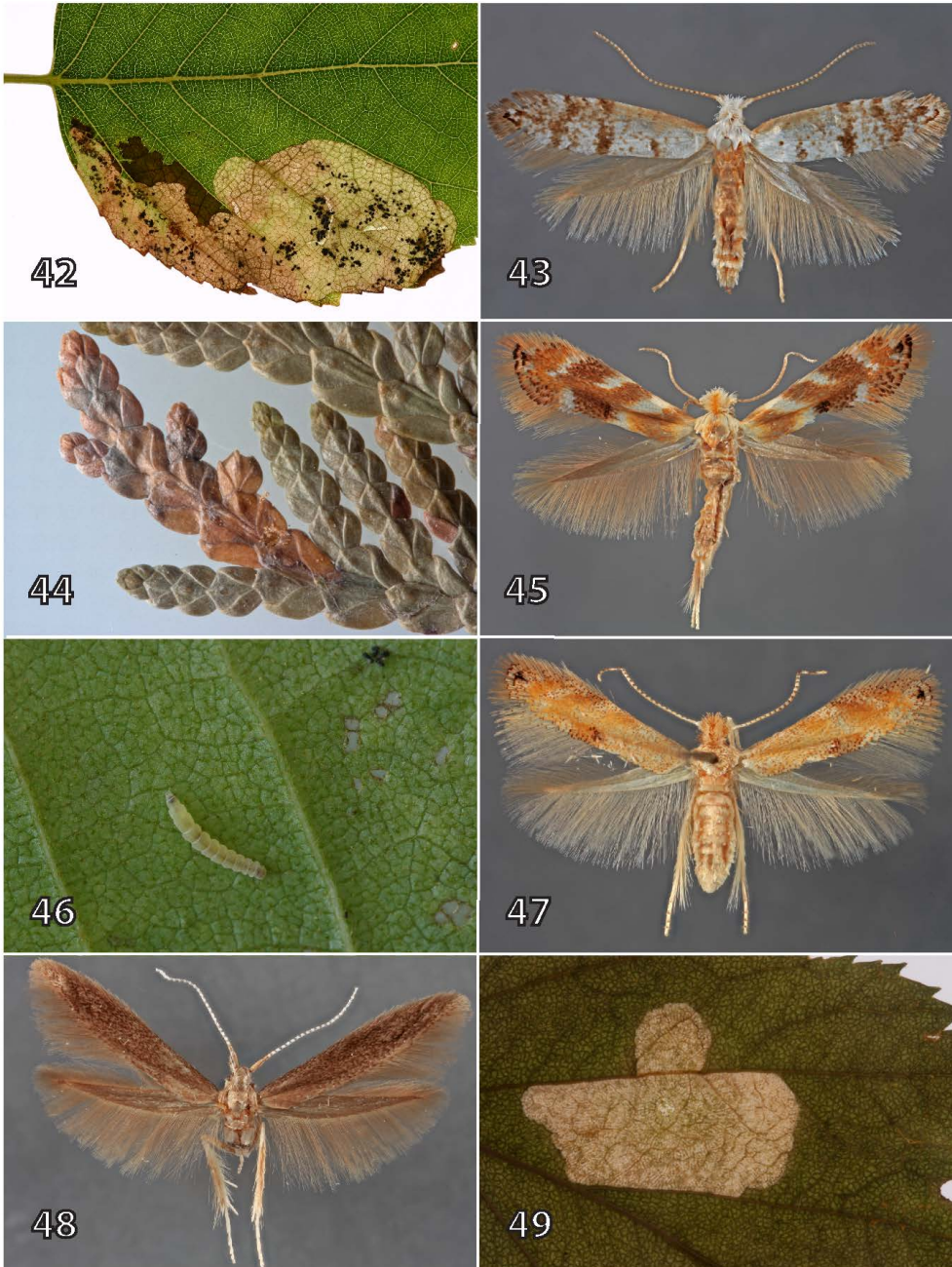
LEPIDOPTERA

Argyresthiidae

Argyresthia thuiella Packard (Fig 43, 44). **Specimen data:** Gillet Landing 46°51.870N 87°46.435W, 7 larvae 11 Jun 2001, 3♀ 27-28 Jun 2001, Lot 1127. **Distribution:** CANADA: Eastern Canada; (Freeman 1972); U.S.A.: ME, PA (Busck 1907); MI (Nielsen 1998). **Larval hosts:** *Thuja occidentalis* L. (Freeman 1972). *Thuja occidentalis* (identified in this survey). **Parasitoids:** **Braconidae:** *Apanteles (Apanteles) epinotiae* Viereck, *Apanteles (Apanteles) paralechiae* Muesebeck, *Apanteles (Apanteles) thujae* Muesebeck, *Bracon (Bracon) speerschneideri* Schmiedeknecht, *Charmon extensor* (Linnaeus), *Chelonus (Microchelonus) recurvariae* McComb, *Hypomicrogaster zonaria* (Say), *Pholetesor bedelliae* (Viereck), *Pholetesor thuiellae* Whitfield; **Ichneumonidae:** *Porizon cupressi* (Ashmead) (Yu et al. 2012). **Chalcididae:** *Conura albifrons*, *C. side* (Walker); **Encyrtidae:** *Copidosoma bucculatricis* (Howard); **Eulophidae:** *Baryscapus coeruleus* (Ashmead), *Cirrospilus vittatus*, *Closterocerus trifasciatus*, *Di cladocerus* sp., *Di cladocerus vulgaris* Yoshimoto, *Euderus cushmani* (Crawford), *Necremnus* sp., *Neochrysocharis formosa* (Westwood), *Pediobius albipes*, *Pnigalio* sp., *Pnigalio maculipes*, *Pnigalio minio*, *Sympiesis stigmatipennis* Girault; **Eupelmidae:** *Eupelmus vesicularis* (Retzius) (Noyes 2018). **Eulophidae:** *Pnigalio maculipes*, *Sympiesis sericeicornis* (identified in this survey). **Remarks:** The solitary larva consumes all green tissue throughout the mined area though that area remains opaque. Pupation occurs within the mine. This is a new host record for *Sympiesis sericeicornis*.

Bucculatricidae

Bucculatrix canadensisella Chambers (Fig. 45, 46). **Specimen data:** Salmon Trout Bay 46°51.870N 87°46.435W, 8 larvae 25-26 Sep 2000, 1♂ after wintering, Lot 1082; same site, 14+ larvae 16 Sep 2006, 3♂, 6♀ after wintering, Lot 1758; same site, 1 larva 19 Sep 2007, 1♀ after wintering, Lot 1849. **Distribution:** CANADA: AB, BC, MB, NB, NS, ON, PE, QC, SK; U.S.A.: CO, KY, MI, MN, NJ, NY, NC, PA, TN, WI (Friend 1927, Braun 1963). **Larval hosts:** *Betula lenta* L., *B. lutea* Michx., *B. nigra*, *B. occidentalis*, *B. papyrifera*, *B. populifolia* (Braun 1963). *Betula papyrifera* (identified in this survey).



Figures 42–49. **Fig. 42.** *Profenusa* sp. prob. *thomsoni*: completed mine. **Fig. 43.** *Argyresthia thuiella*: adult. **Fig. 44.** *Argyresthia thuiella*: completed mine. **Fig. 45.** *Bucculatrix canadensisella*: adult. **Fig. 46.** *Bucculatrix canadensisella*: late instar larva skeletonizing lower leaf surface. **Fig. 47.** *Bucculatrix packardella*: adult. **Fig. 48.** *Coleophora pruniella*: adult. **Fig. 49.** *Coleophora pruniella*: lower leaf surface with circular entrance in mine.

Parasitoids: Braconidae: *Cantharoctonus canadensis* Mason, *Pholetesor bedelliae*, *Pholetesor thuiellae*, *Stiropius bucculatricis*; **Ichneumonidae:** *Campoplex brachyurus* Viereck, *Gelis obscurus*, *Gelis urbanus* (Yu et al. 2012). **Chalcididae:** *Haltichella xanticles* (Walker); **Eulophidae:** *Chrysocharis nephereus*, *Cirrospilus cinctithorax*, *Cirrospilus ocellatus* Girault, *Closterocerus cinctipennis*, *Derostenus* sp., *Pediobius bucculatricis* (Gahan) (Noyes 2018). **Braconidae:** *Stiropius bucculatricis*; **Eulophidae:** *Pediobius albipes* (identified in this survey). **Remarks:** Though the early instar larva is a miner, the later instar is a lower leaf surface skeletonizer occasionally feeding on the upper surface. The larva is pale yellow with white pinacula and brown setae. The cocoon is dark brown with six ribs. This is a new host record for *Pediobius albipes*. Though *Mesochorus americanus* Cresson, *M. parvus* Dasch, and *M. vittator* (Zetterstedt) are listed as parasitoids in Yu et al. (2012), they are known to be hyperparasitoids (RRK).

Bucculatrix packardella Chambers (Fig. 47). **Specimen data:** Base of Breakfast Roll Mountain 46°50.892N 87°49.783W, 1 cocoon 20 Sep 2003, 1♀ after wintering, Lot 1475. **Distribution:** CANADA: ON; U.S.A.: DE, DC, MI, NJ, NY, OH, PA, RI (Braun 1963). **Larval hosts:** *Quercus* spp., *Quercus shumardii* Buckley (Braun 1963). *Quercus rubra* (identified in this survey). **Parasitoids: Eulophidae:** *Pnigalio maculipes* (Noyes 2018). **Remarks:** The nearly fully developed larva skeletonizes the lower leaf surface. The single cocoon recovered was white with seven to eight ribs. Braun (1963) states that 10 – 12 ribs are usual.

Coleophoridae

Coleophora pruniella Clemens (Fig. 48, 49). **Specimen data:** Stone House 46°50.627N 87°51.300W, 1 case affixed to upper leaf surface 05 Jun 2006, 1♂ 23 Jun 2006, Lot 1696. **Distribution:** U.S.A.: OH, PA (Braun 1914); MI (Nielsen 1998). **Larval hosts:** *Alnus* sp., *Betula* sp., *Crataegus* sp., *Malus* sp., *Populus* sp., *Prunus* sp., *Salix* sp. (Bucheli et al. 2002). *Crataegus* sp. (identified in this survey). **Parasitoids: Chalcididae:** *Conura* sp., *Conura albifrons*, *Conura side*; **Encyrtidae:** *Copidosoma truncatellum* (Dalman); **Eulophidae:** *Chrysocharis* sp., *Chrysocharis ainsliei*, *C. laricinellae* (Ratzeburg), *C. pentheus*, *Cirrospilus* sp., *Cirrospilus cinctithorax*, *C. flavicinctus*, *Closterocerus* sp., *Closterocerus trifasciatus*, *Derostenus* sp., *Elachertus* sp., *Elachertus fenestratus* Nees, *Elasmus setosiscutellatus* Crawford, *Euderus cushmani*, *Eulophus* sp., *Eulophus magnisulcatus* Girault, *Horismenus* sp., *Horismenus fraternus* (Fitch),

Minotetrastichus frontalis, *Pnigalio* sp., *P. maculipes*, *P. minio*, *P. pallipes* (Provancher), *Sympiesis* sp., *S. sericeicornis*, *S. stigmata* Girault, *Tetrastichus* sp., *Zagrammosoma* sp.; **Eupelmidae:** *Eupelmus vesicularis*; **Eurytomidae:** *Eurytoma appendigaster* (Swederus), *E. verticillata* (Fabricius); **Pteromalidae:** *Catolaccus aeneoviridis* (Girault), *Catolaccus kansensis* (Girault), *Hypopteromalus inimicus* Muesebeck, *Hypopteromalus percussor* Girault, *Pteromalus* sp., *P. phycidis* (Ashmead), *P. thyridopterigis* (Howard), *Sceptrothelys deione* (Walker), *Trichomalopsis* sp.; **Torymidae:** *Torymus* sp.; **Tricogrammatidae:** *Tricogramma minutum* (Noyes 2018). **Braconidae:** *Bracon (Bracon) pygmaeus* Provancher, *Habrobracon gelechia* (Ashmead); **Ichneumonidae:** *Campoplex mellipes* (Provancher), *Diphyus comes* (Cresson), *Gelis tenellus* (Say), *Ichneumon annulatorius* Fabricius, *Itoplectis conquisitor* (Say), *Itoplectis quadricingulata* (Provancher), *Scambus calobatus* (Gravenhorst), *Scambus decorus* Walley, *Scambus hispae*, *Spilichneumon inconstans* (Cresson) (Yu et al. 2012). **Remarks:** One case was recovered affixed to the upper surface of a *Crataegus* leaf. Several scattered blotch mines were present on adjacent leaves. Mines contained no frass, but each had a circular hole in the center of the mine on the lower surface characteristic of coleophorid larval feeding. The initial portion of the cases is light tan while the later portion is darker.

Eriocraniidae

Eriocrania sp. prob. *semipurpurella* Stephens (Fig. 50). **Specimen data:** Picnic Point 46°53.056N 87°50.509W, 3 live larvae 05 Jun 2006, no adults, Lot 1697; Upper Falls Road 46°50.627N 87°51.300W, 3 mines, 2 with dead larvae, third vacant 08 Jun 2006, 0 adults, Lot 1703. **Distribution:** Great Britain, northern and central Europe, Japan; CANADA: NS, ON, QC; U.S.A.: NY (Davis 1978). **Larval hosts:** *Betula pendula* Roth, *B. pubescens* Ehrh., *B. platyphylla* Sukaczew var. *japonica* (Miq.) Hara (hosts not from North America) (Davis 1978). *Betula papyrifera* (Lot 1697) and *B. alleghaniensis* (Lot 1703) (identified in this survey). **Parasitoids: Braconidae:** *Colastes (Shawiana) catenator*; **Ichneumonidae:** *Gryptocentrus basalis* Ruthe, *Lathrolestes (Lathrolestes) clypeatus* (Zetterstedt) (Yu et al. 2012); **Eulophidae:** *Aprostocetus pallipes* (Dalman), *Chrysocharis nephereus*, *Cirrospilus lynceus* Walker, *C. pictus*, *Closterocerus trifasciatus*, *Minotetrastichus frontalis*, *Pnigalio eriocraniae* Li and Yang, *P. longulus* (Zetterstedt), *P. soemius* (Noyes 2018). **Remarks:** There are one to two mines per leaf with a single

larva in each. The full depth mine is initiated at the leaf edge, developing as a widening track. Frass at the mine origin is densely packed, but as the mine expands frass clearly appears as long black strings. Prior to pupating the larva exits its mine through either the upper or lower leaf surface. Preserved larvae were identified to family (Davis 1987). Davis lists various *Betula* species as hosts in the Palearctic though none in North America. The mine characteristics described and illustrated here agree with the image of this species on the website <http://www.leafmines.co.uk/> (2009).

Gelechiidae

Scrobipalpa manierreorum Priest (Fig. 51, 52). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 6 larvae 17 Aug 2004, 0 adults, Lot 1523; same site, 7 larvae 13 Sep 2005, 4 adults after wintering, Lot 1654; same site, 3 mines 14 Sep 2006, 0 adults Lot 1763; same site, 4 larvae 28 Aug 2007, 3 adults after wintering, Lot 1835; same site, 2 larvae 27 Aug 2008, 2 adults after wintering, Lot 1872; Upper Falls Road 46°50.475N 87°50.581W, 2 mines 17 Sep 2006, 1 adult, Lot 1768; Ives Lake Rd. at Club Rd. 46°50.926N 87°48.012W, 9 larvae 28 Aug 2007, 1 adult after wintering, Lot 1834; Quarry-Fen 46°53.839N 87°53.607W, 20 mines 28 Aug 2010, 2 adults after wintering, Lot 1989. **Distribution:** CANADA: AB, BC, MB, ON, QC; U.S.A.: MI (Adamski et al. 2014). **Larval hosts:** *Eurybia* (*Aster*) *macrophylla* (Adamski et al. 2014). **Parasitoids:** **Braconidae:** *Schoenlandella minuta* (Cresson); **Ichneumonidae:** *Campoplex* sp. (Adamski et al. 2014). **Remarks:** One to 14 mines occur per leaf though miners are solitary. The mine usually begins at the main vein extending toward the leaf margin as a full depth narrow branching tract. Frass is fastened with silk externally on the lower surface at the mine base forming a curved tube. It is used as a larval retreat if disturbed or not feeding. Frass is also placed in the mine as double rows, which serve to guide the larva backward to its frass tube based on RJP observations. When feeding is complete the larva exits its mine through its frass tube to winter on the ground. There was only a single generation observed in the study. Most of the above data was originally published in Adamski et al. (2014).

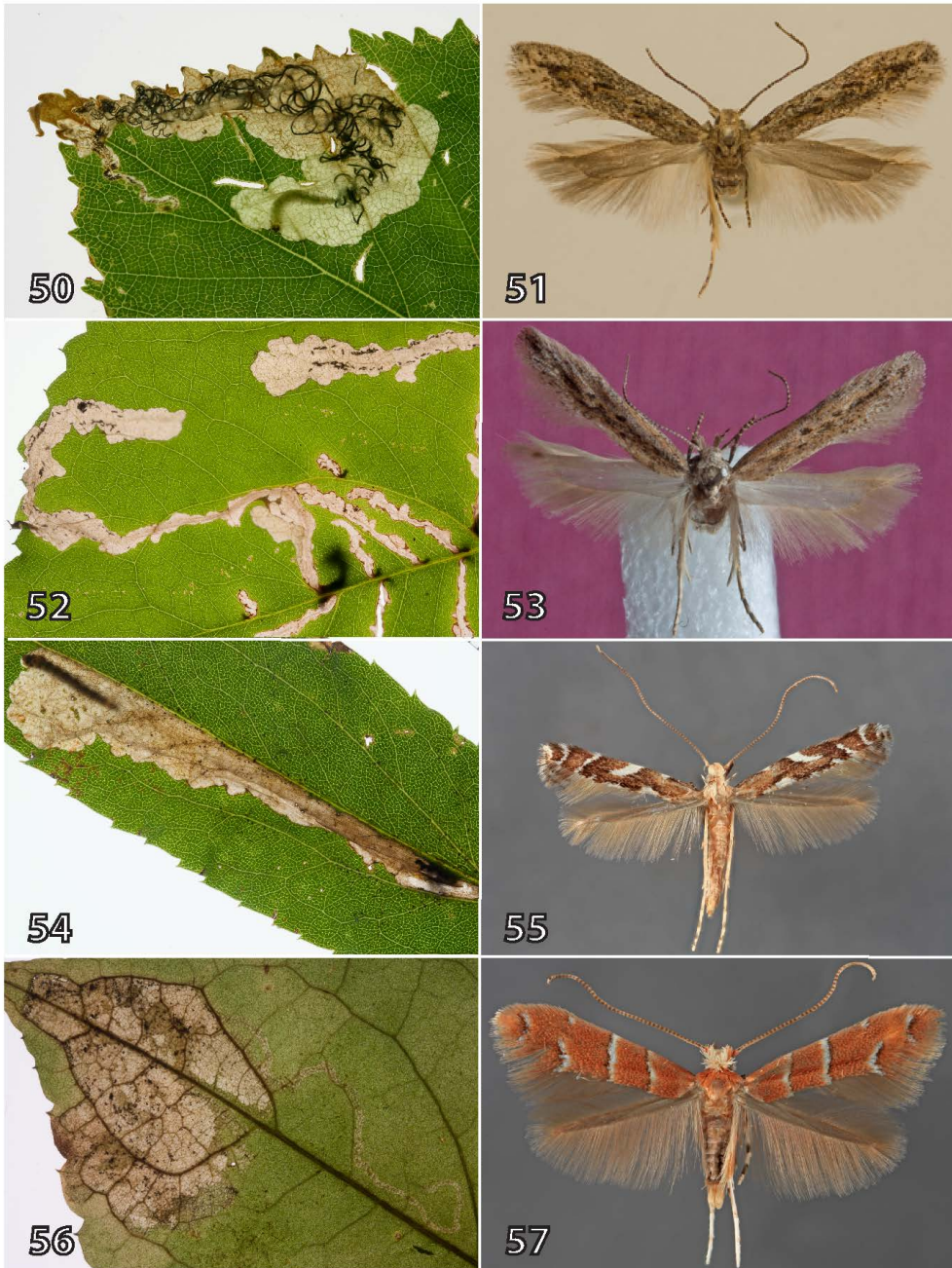
Scrobipalpa sacculicola (Braun) (Fig. 53, 54). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 1 larva 20 Sep 2007, 1 ♀ after wintering, Lot 1844. **Distribution:** CANADA: ON, QC; U.S.A.: CO, LA, MI, OH, OK (V. Nazari, personal communication). **Larval hosts:** *Solidago* sp., (Braun 1925). *Solidago* sp. (identified in this

survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** The single mine recovered contained one larva. The full depth mine begins basally between the main vein and a secondary vein. It develops as a straight gradually expanding track along one side of the main vein toward the leaf apex. Frass is minute, black, and sparse. Most frass is expelled through a hole in the mine floor at its origin.

Gracillariidae

Acrocercops astericola (Frey and Boll) (Fig. 55, 56). **Specimen data:** Trail near Burnt Dam 46°48.720N 87°48.772W, 13 larvae 24 Sep 2001, 2♂, 1♀ after wintering, Lot 1245; Ives Lake Rd. at Club Rd. 46°50.926N 87°48.012W, 11 larvae 23 Sep 2002, 2♂, after wintering, Lot 1354; same site, 9 larvae 20 Sep 2003, 1♂ after wintering, Lot 1449. **Distribution:** CANADA: NS, QC; U.S.A.: KY, ME, MA, MI, NY, PA, VT (De Prins and De Prins 2005). **Larval hosts:** *Aster cordifolius* L., *A. corymbosus* Sols. Ex Aiton, *A. divaricatus*, *A. novibelgii* L., *A. lateriflorus* (L.) Britton, *Inula germanica* L. (De Prins and De Prins 2005). *Eurybia* (*Aster*) *macrophylla* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Eulophidae:** *Pediobius alcaeus* (Walker); **Braconidae:** *Colastes* sp. 1, *Pholetesor* (♂) (identified in this survey). **Remarks:** There are one to four mines per leaf but only one miner in each. Initially the mine is serpentine later widening into a blotch. The initial portion is usually clearly visible on the upper leaf surface, but upon expanding the mine may be full depth or meander between leaf surfaces. Frass in the serpentine part is a light colored central trail but with clearly scattered black particles in the blotch portion. The feeding larva is tan colored, but upon exiting its mine, via the upper leaf surface, its color turns pink. The cocoon is pale pink and approximately 5.5 × 1.4 mm. The specimens of *Colastes* and *Pholetesor* are the first species of Braconidae reported as parasitic on *A. astericola*. This is a new host record for *Pediobius alcaeus*.

Cameraria aceriella (Clemens) (Fig. 57, 58). **Specimen data:** Howe Lake 46°53.823N 87°57.668W, 5 larvae 28 Sep 2000, 1♀ after wintering, Lot 1098; Quarry-Fen 46°53.839N 87°53.607W, 5+ larvae 17 Sep 2003, 1♂, 2♀ after wintering, Lot 1438; Flat Rock 46°54.520N 87°55.355W, 5 larvae 12 Sep 2005, 0 adults, Lot 1647. **Distribution:** CANADA: QC; U.S.A.: CT, IL, KY, ME, MD, MI, NY, PA, VT, WI (De Prins and De Prins 2005). **Larval hosts:** *Acer rubrum* L., *A. saccharinum* L., *A. saccharum* (De Prins and De Prins 2005). *Acer saccharum* (identified in this survey). **Parasitoids:**



Figures 50–57. **Fig. 50.** *Eriocrania* sp. prob. *semipurpurella*: larva feeding on *Betula papyrifera*. **Fig. 51.** *Scrobipalpula manierreorum*: adult male, holotype. **Fig. 52.** *Scrobipalpula manierreorum*: completed mine reaching leaf edge with curved basal frass tube visible on lower surface. Several additional mines are present, mostly initiated along main vein. **Fig. 53.** *Scrobipalpula sacculicola*: adult. **Fig. 54.** *Scrobipalpula sacculicola*: mine with feeding larva. **Fig. 55.** *Acrocercops astericola*: adult. **Fig. 56.** *Acrocercops astericola*: completed mine. **Fig. 57.** *Cameraria aceriella*: adult.

Eulophidae: *Chrysocharis occidentalis* (Girault), *Pediobius alcaeus*, *Phnigalio pallipes* (Noyes 2018); **Braconidae:** *Centistidea (Centistidea) lithocolletidis* (Ashmead), *Pholetesor ornigis* (Weed); **Ichneumonidae:** *Alophosternum foliicola* (Yu et al. 2012). **Braconidae:** *Pholetesor* sp. 2, *Pholetesor* (♂) (identified in this survey). **Remarks:** One to three mines occur per leaf but each with only a single miner. The mine is a wide track at times recurving to form an apparent blotch. Black frass forms a narrow trail along the mine perimeter. Pupation occurs in the mine. The larva forms an approximately 6.0 × 5.0 mm white cocoon at its mine terminus.

Cameraria bethunella (Chambers) (Fig. 59, 60). **Specimen data:** Lily Pond 46°50.892N 87°49.783W, 3 pupating larvae 26 Sep 2001, 1♂ after wintering, Lot 1260; same site, 4 larvae 26 Sep 2002, 1♂, 1♀ after wintering, Lot 1358; same site, 9 larvae 22 Sep 2007, 1♂ after wintering, Lot 1848; same site, 17 larvae 04 Oct 2009, 2♂, 4♀ after wintering, Lot 1956; Canyon Lake 46°83.289N 87.92.101W, 5 larvae 27 Sep 2002, 1♂ after wintering, Lot 1362; Lily Pond 46°50.892N 87°49.783W, 12 larvae 18 Sep 2006, 2♂, 1♀ after wintering, Lot 1770; Main and Flat Rock Roads 46°53.651N 87°55.171W, 3 larvae 18 Sep 2007, 2♂ after wintering, Lot 1839; River Styx 46°50.627N 87°1.300W, 3 larvae 25 Sep 2008, 1♂ after wintering, Lot 1907. **Distribution:** CANADA: QC; U.S.A.: CT, IL, KY, ME, NY, TX (De Prins and De Prins 2005). **Larval hosts:** *Quercus obtusiloba* Michx., *Q. tinctoria* W. Bartram, *Q. imbricaria* Michx., *Q. macrocarpa*, *Q. ilicifolia*, *Q. rubra*, *Q. velutina* Lam., *Castanea dentata* (Marshall) Borkh. (De Prins and De Prins 2005). *Quercus rubra* (identified in this survey). **Parasitoids:** **Braconidae:** *Colastes (Shawiana) metalli* (Yu et al. 2012). **Remarks:** Usually there is only one mine per leaf, but as many as four were seen. The larva is solitary. This upper surface mine is oval with some lobing. Frass is scattered and appears as black spots. The larva usually forms a tentiform area toward the mine center prior to pupating. This area is usually apparent by three longitudinal wrinkles on the upper surface.

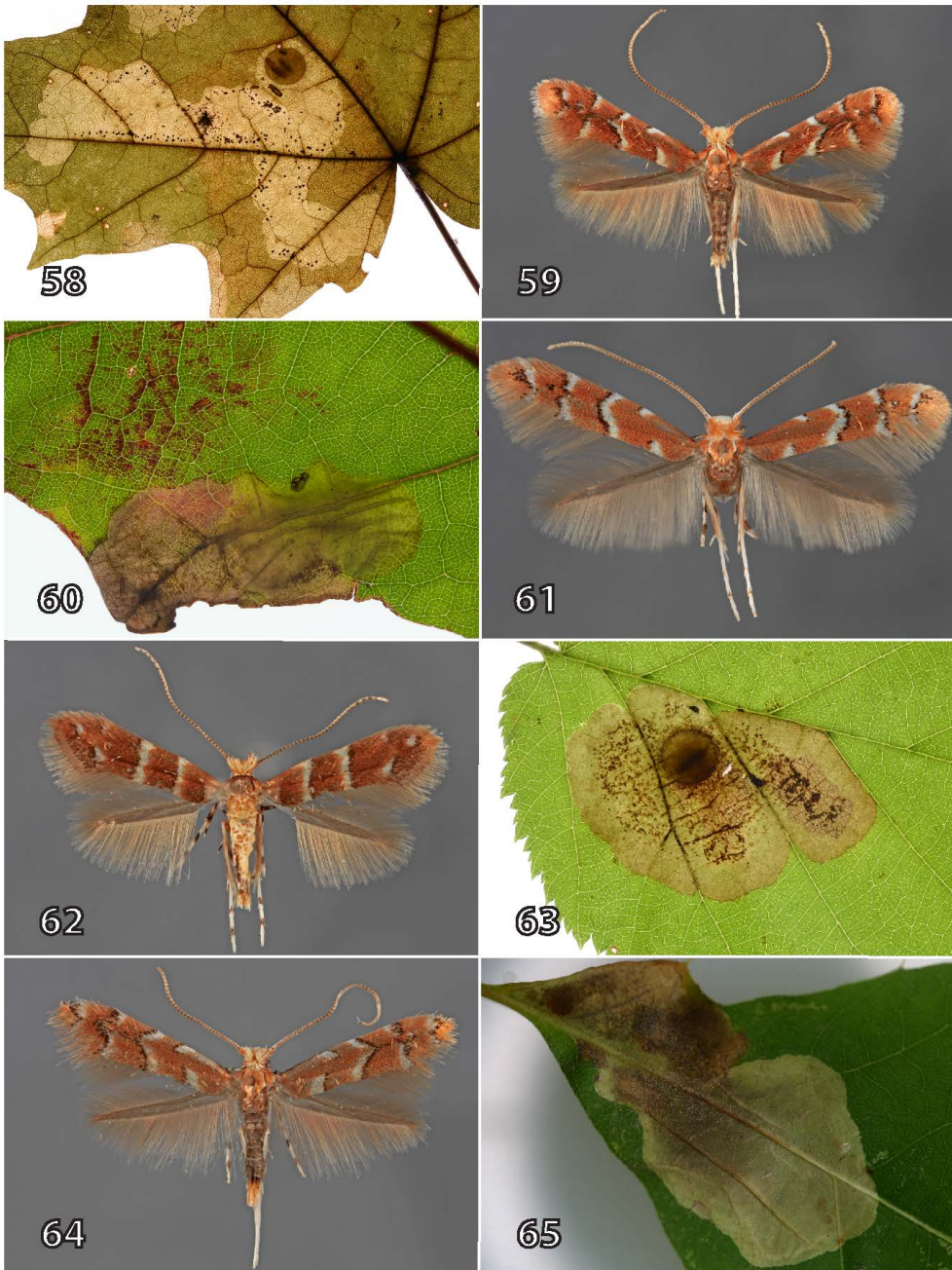
Cameraria betulivora (Walsingham) (Fig. 61). **Specimen data:** Quarry-Fen 46°53.839N 87°53.607W, 4 larvae 17 Sep 2003, 1♂ after wintering, Lot 1440. **Distribution:** CANADA: U.S.A.: ME, NC (De Prins and De Prins 2005). **Larval hosts:** *Betula lutea*, *B. lenta*, *B. alleghaniensis*, *B. papyrifera*, *B. populifolia* (De Prins and De Prins 2005). *Betula papyrifera* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** This upper surface blotch mine contains a

single larva. Frass is scattered but with a concentration toward the middle of its mine.

Cameraria corylisella (Chambers) (Fig. 62, 63). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 5 completed mines 13 Sep 2005, 2♀ after wintering, Lot 1649. **Distribution:** CANADA: QC; U.S.A.: CT, IL, KY, ME, NY, VT, WI (De Prins and De Prins 2005). **Larval hosts:** *Corylus americana* Walt., *Ostrya virginiana* (Miller) K. Koch, *Carpinus americana* Walt., *C. caroliniana* Walt. (De Prins and De Prins 2005). *Corylus cornuta* Marsh. (identified in this survey). **Parasitoids:** **Eulophidae:** *Pediobius ocellatus* Peck; **Braconidae:** *Pholetesor ornigis*; **Ichneumonidae:** *Alophosternum foliicola* (Yu et al. 2012) (identified in this survey). **Remarks:** The larva constructs an upper surface lobed blotch mine. The solitary larva produces scattered frass away from the mine perimeter. Pupation occurs within its mine in a 5.0 mm circular ridged pupal chamber. This latter observation differs from Braun (1908) but agrees with Maier and Davis (1989). This is a new host record for *Pediobius ocellatus*.

Cameraria fletcherella (Braun) (Fig. 64, 65). **Specimen data:** Lily Pond 46°50.892N 87°49.783W, 3 completed mines 16 Sep 2005, 1♂ after wintering, Lot 1660. **Distribution:** CANADA: ON, QC; U.S.A.: IL, ME (De Prins and De Prins 2005). **Larval hosts:** *Quercus alba* (Braun 1908), *Quercus rubra* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** The larva is a solitary feeder. Frass is brown spotting away from the mine perimeter. The completed mine is a lobed upper surface blotch with two parallel wrinkles on its upper surface above its pupal chamber.

Cameraria lentella (Braun) (Fig. 66, 67). **Specimen data:** Borrow Pit 46°53.140N 87°56.919W, 21 larvae 25 Sep 2002, 1♂, 3♀ after wintering, Lot 1355; Quarry-Fen 46°53.839N 87°53.607W, 4 larvae 18 Jul 2003, 1♂, 1♀ 07 Aug 2003, Lot 1425; Main and Flat Rock Roads 46°53.651N 87°55.171W, 8 larvae 18 Sep 2007, 3♂, 5♀ after wintering, Lot 1850; same site, 35 larvae 22 Sep 2011, 6♂, 4♀ after wintering, Lot 2039. **Distribution:** CANADA: QC; U.S.A.: AZ, CT, GA, IL, ME, MD, NJ, NY, OH, VT (De Prins and De Prins 2005). **Larval hosts:** *Ostrya virginiana* (De Prins and De Prins 2005). *Ostrya virginiana* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Braconidae:** *Pholetesor* sp. 1, *Pholetesor* sp. 2, *Pholetesor* (♂); **Eulophidae:** *Chrysocharis occidentalis* (identified in this survey). **Remarks:** This gregarious species forms an upper surface irregular blotch mine frequently centered over the main vein. When completed, longitudinal



Figures 58–65. **Fig. 58.** *Cameraria aceriella*: cocoon visible in completed mine. **Fig. 59.** *Cameraria bethunella*: adult. **Fig. 60.** *Cameraria bethunella*: completed mine with three wrinkles visible. **Fig. 61.** *Cameraria betulivora*: adult. **Fig. 62.** *Cameraria corylisella*: adult. **Fig. 63.** *Cameraria corylisella*: completed mine with cocoon. **Fig. 64.** *Cameraria fletcherella*: adult. **Fig. 65.** *Cameraria fletcherella*: completed mine with two wrinkles visible.

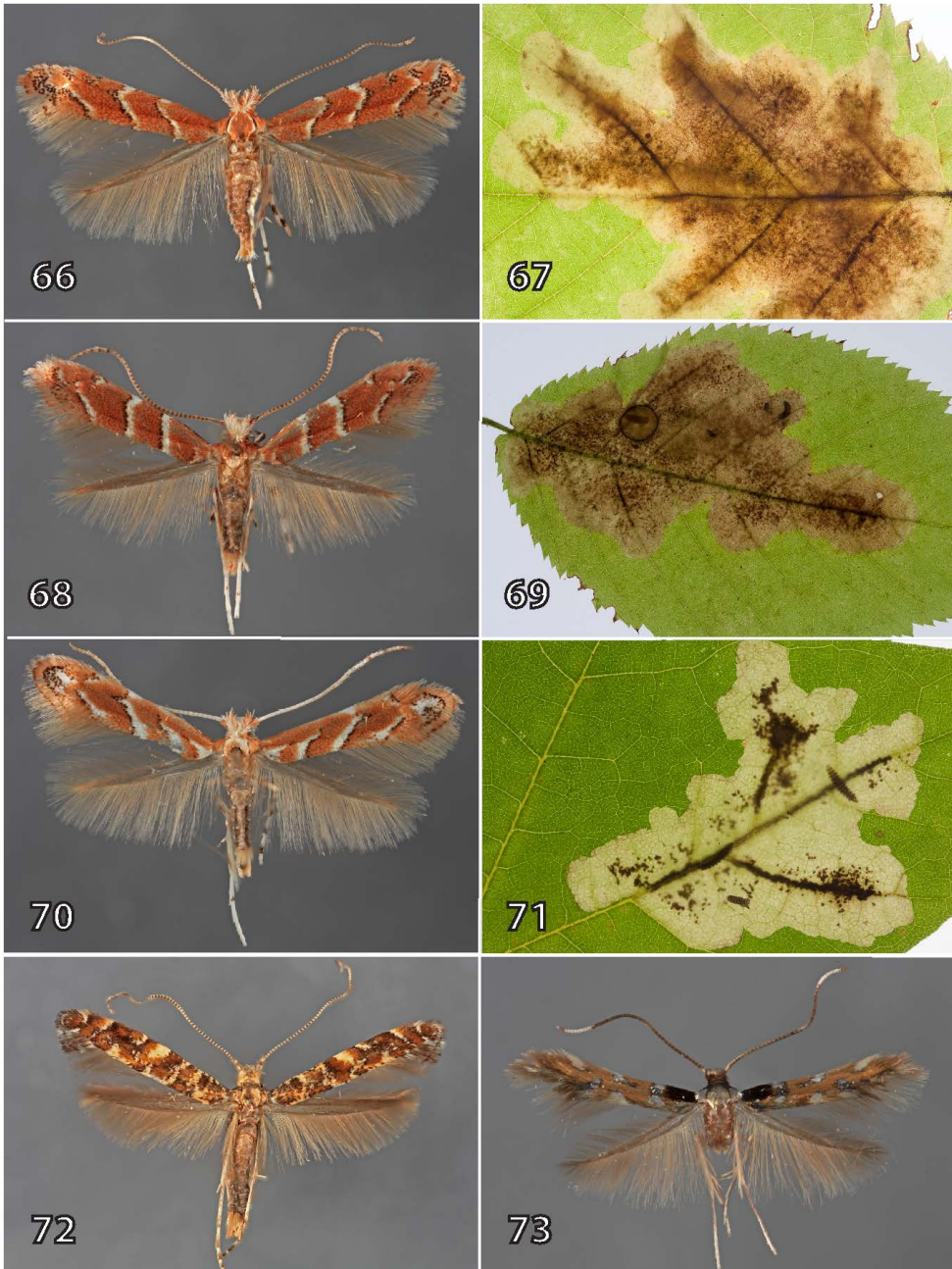
wrinkles are apparent on the upper mine surface. Frass appears as brown spotting on the mine floor. Mines were recovered in both mid-July and again in mid- to late September and both produced adults, confirming two generations at this location as Maier and Davis (1989) reported for Connecticut. The specimens of *Pholetesor* reared in this research are the first species of Braconidae reported as parasitic on *C. lentella*. This is a new host record for *Chrysocharis occidentalis*.

Cameraria ostryarella (Chambers) (Fig. 68, 69). **Specimen data:** Borrow Pit 46°53.140N 87°56.919W, 1 larva 25 Sep 2002, 1♀ after wintering, Lot 1593; Loop Road 46°50.627N 87°51.300W, 7 larvae and 11 cocoons 13 Sep 2005, 2♂, 1♀ after wintering, Lot 1650; Quarry-Fen 46°53.839N 87°53.607W, 8 cocoons 15 Sep 2005, 0 adults, Lot 1656; same site, 7 larvae 15 Sep 2006, 0 adults, Lot 1766; Main and Flat Rock Roads 46°53.651N 87°55.171W, 3 larvae 18 Sep 2007, 3♂ 6♀ after wintering, Lot 1838; same site, 10 larvae 22 Sep 2011, 3♂, 6♀ after wintering, Lot 2038. **Distribution:** CANADA: QC; U.S.A.: CT, IL, KY, ME, MI, NY, VT (De Prins and De Prins 2005). **Larval hosts:** *Carpinus caroliniana*, *Ostrya virginiana* (De Prins and De Prins 2005). *Ostrya virginiana* (identified in this survey). **Parasitoids:** **Eulophidae:** *Sympiesis gordius* (Noyes 2018); **Braconidae:** *Pholetesor ornigis* (Yu et al. 2012). **Encyrtidae:** *Ageniaspis bicoloripes* (Girault); **Eulophidae:** *Baryscapus* sp., *Pediobius ocellatus*, *Sympiesis sericeicornis*; **Braconidae:** *Pholetesor* (♂) (identified in this survey). **Remarks:** One to two mines per leaf with one to four larvae per mine. Completed mines are lobed blotches. The mature larva forms a cocoon in its mine as was described for *C. caroliniana* and *O. virginiana* in Braun (1908): “circular silk-lined chambers, the outline appearing on the upper epidermis as a circular narrow ridge; a convex projection appears on the lower side.” Its circular outline above measures 4.3–5.0 mm in four cocoons measured. This is a new host record for *Ageniaspis bicoloripes*, *Baryscapus* sp., *Pediobius ocellatus*, and *Sympiesis sericeicornis*.

Cameraria saccharella (Braun) (Fig. 70, 71). **Specimen data:** Quarry-Fen 46°53.839N 87°53.607W, 13 larvae 08 Aug 2010, 4♂, 2♀ after wintering, Lot 1988. **Distribution:** CANADA: QC; U.S.A.: CT, IL, ME, NJ, NY, OH, VT (De Prins and De Prins 2005). **Larval hosts:** *Acer nigrum* Michx., *A. rubrum*, *A. saccharinum*, *A. saccharum* (De Prins and De Prins 2005). *Acer saccharum* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012. Noyes 2018). **Remarks:** All mines were recovered from the maple reproduction layer (see discussion section under *Brachys aeruginosus*). The

mine is placed over the main and secondary veins producing a symmetric pattern. Frass is also placed directly over veins with the solitary larva frequently aligned cryptically with frass and vein. The final instar larva constructs an elongate cocoon that tapers at each end in its mine.

Gracillaria syringella (Fabricius) (Fig. 72). **Specimen data:** Stone House 46°50.627N 87°51.300W, 7 mines with multiple larvae in each 29 Jun 2000, 16♂, 17♀ 17–29 Jul 2000, Lot 1023; same site, 1 mine with nine larvae 20 Aug 2004, 1♂, 1♀ 14–16 Sep 2004, Lot 1524. **Distribution:** Palearctic; CANADA: NS, QC; U.S.A.: ME, MI, VT (De Prins and De Prins 2005). **Larval hosts:** *Deutzia* sp., *Euonymus europaea* L., *Fraxinus excelsior* L., *F. nigra* Marsh., *Jasminum officinale* L., *Ligustrum lucidum* Ait., *L. vulgare* L., *Syringa vulgaris* L., (De Prins and De Prins 2005). *Syringa vulgaris* (identified in this survey). **Parasitoids:** **Eulophidae:** *Asecodes erxias* (Walker), *Chrysocharis laomedon* (Walker), *Cirrospilus diallus* Walker, *C. pictus*, *C. vittatus*, *Closterocerus trifasciatus*, *Elachertus artaeus* (Walker), *E. inunctus* Nees, *Minotetrastichus frontalis*, *Pnigalio longulus*, *P. soemius*, *Sympiesis gordius*, *S. sericeicornis*; **Pteromalidae:** *Pteromalus semotus* (Walker) (Noyes 2018); **Braconidae:** *Apanteles* (*Apanteles*) *candidatus* (Haliday), *Apanteles* (*Apanteles*) *dilectus* (Haliday), *Apanteles* (*Apanteles*) *gracilariae* Wilkinson, *Apanteles* (*Apanteles*) *impurus* (Nees), *Apanteles* (*Apanteles*) *longicauda* (Wesmael), *Apanteles* (*Apanteles*) *obscurus* (Nees), *Ascogaster rufidens* Wesmael, *Bracon* (*Glabrobracon*) *abbreviator* Nees, *Bracon* (*Bracon*) *minutator* (Fabricius), *Cotesia perspicua* (Nees), *Earinus elator* (Fabricius), *Pholetesor circumscriptus* (Nees), *Pholetesor pedias* (Nixon), *Pholetesor viminetorum* (Wesmael), *Protapanteles* (*Protapanteles*) *lateralis* (Haliday), *Rhysipolis mediator* (Haliday); **Ichneumonidae:** *Campoplex continuus* (Thomson), *Campoplex pyraustae* Smith, *Clypeoplex cerophagus* (Gravenhorst), *Diadegma coleophorarum* (Ratzeburg), *Diadegma stigmatellae* Horstmann, *Encrateola laevigata* (Ratzeburg), *Gelis aerator* (Panzer), *Hyposoter leucomerus* (Thomson), *Leptocampoplex cremastoides* (Holmgren), *Porizon transfuga* (Gravenhorst), *Scambus calobatus*, *Scambus inanis* (Schrank), *Scambus pomorum* (Ratzeburg), *Scambus sagax* (Hartig), *Stictopisthus formosus* (Bridgman), *Triclistus podagricus* (Gravenhorst) (Yu et al. 2012). **Remarks:** Mines were found only on the lower portion of the host plant. The initial mine is a dull green upper surface blotch. Maturing larvae leave their colonial mine and roll a leaf feeding gregariously as skeletonizers. Larvae are pale yellow prior to pupating. Pupation occurs in a white cocoon.



Figures 66–73. **Fig. 66.** *Cameraria lentella*: adult. **Fig. 67.** *Cameraria lentella*: four completed mines with tentiform pupal areas visible. **Fig. 68.** *Cameraria ostryarella*: adult. **Fig. 69.** *Cameraria ostryarella*: two miners with one circular cocoon in *Ostrya virginiana*. **Fig. 70.** *Cameraria saccharella*: adult. **Fig. 71.** *Cameraria saccharella*: larva on vein and second larva perpendicular on same vein with some frass placed over veins. **Fig. 72.** *Gracillaria syringella*: adult. **Fig. 73.** *Leucanthiza dircella*: adult.

This species clearly has two generations per year at this survey site and agrees with Murdoch's (1967) observations.

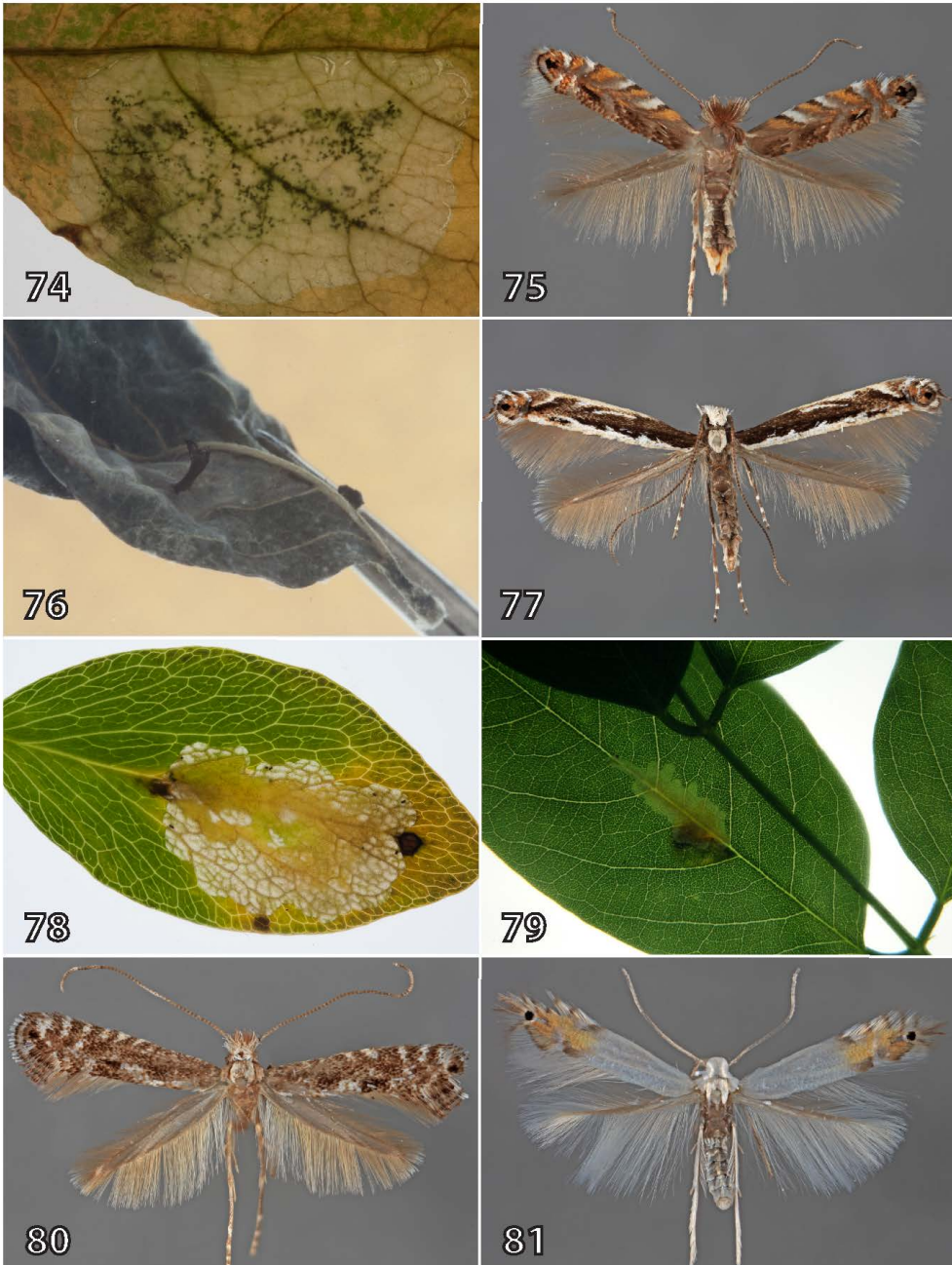
Leucanthiza dircella Braun (Fig. 73, 74). **Specimen data:** Ives Lake Rd. 46°50.475N 87°50.581W, 10 larvae 25 Sep 2001, 2♂ after wintering, Lot 1243; same site, 1 larva 17 Sep 2006, 0 adults, Lot 1767. **Distribution:** CANADA: QC; U.S.A.: CA, KY, ME, MI, OH, VT (De Prins and De Prins 2005). **Larval hosts:** *Dirca palustris* L. (De Prins and De Prins 2005). **Parasitoids:** **Eulophidae:** *Chrysocharis occidentalis*, *Chrysocharis polita* (Howard), *Closterocerus trifasciatus*, *Pnigalio* sp., *P. maculipes*, *P. minio*, *P. uroplatae* (Howard), *Sympiesis* sp. (Noyes 2018); **Braconidae:** *Centistidea (Centistidea) lithocolletidis* (Yu et al. 2012). **Eulophidae:** *Chrysocharis occidentalis*, *Closterocerus trifasciatus*, *Pediobius albipes*, and *Pnigalio* sp. (identified in this survey). **Remarks:** The mine is an irregular blotch on the upper leaf surface. There are one to three mines per leaf but only a single larva per mine. Dark frass particles are distributed in indistinct trails away from the mine perimeter. The larva is pale green upon exiting the upper leaf surface. It pupates in an oval white cocoon approximately 2.0 × 4.0 mm. These observations agree with those described by Petrice et al. (2000) for another northern Michigan population. This is a new host record for *Pediobius albipes*.

Macrosaccus robiniella (Clemens) (Fig. 75, 76). **Specimen data:** Ives Lake Road 46°50.475N 87°50.581W, 11 mines 27 Sep 2001, 0 adults, Lot 1256; same site, 12 mines 24 Sep 2002; 1♂ 04 Oct 2002, Lot 1350; same site, 19 mines 17 Aug 2004, 14♂ 20-29 Aug 2004, Lot 1518. **Distribution:** Palearctic; CANADA: QC; U.S.A.: CT, FL, IL, KY, ME, MD, MA, MI, NY, TX, VT, WI (De Prins and De Prins 2005). **Larval hosts:** *Robinia hispida* L., *R. pseudoacacia*, *R. viscosa* Vent. (De Prins and De Prins 2005). *Robinia pseudoacacia* (identified in this survey). **Parasitoids:** **Chalcididae:** *Hockeria unicolor* Walker; **Eulophidae:** *Achrysocharoides gahani* (Miller), *Achrysocharoides robiniae* Hansson and Shevtsova, *A. robinicolus* Hansson and Shevtsova, *Astichus trifasciati-pennis* (Girault), *Baryscapus nigroviolaceus* (Nees), *Chrysocharis laomedon*, *Cirrospilus elegantissimus* Westwood, *C. viticola* (Rondani), *Closterocerus cinctipennis*, *Elachertus inunctus*, *Minotetrastichus frontalis*, *Pediobius liocephalatus* Peck, *P. saulius* (Walker), *Sympiesis acalle* (Walker), *S. gordius* (Noyes 2018); **Braconidae:** *Colastes (Colastes) braconius* Haliday, *Meteorus pendulus* (Müller), *Pholetesor circumscriptus*, *Pholetesor nanus* (Reinhard), *Pholetesor ornigis*, *Pholetesor pedias*; **Ichneumonidae:** (Yu et al. 2012).

Braconidae: *Pholetesor* sp. 1 and *Pholetesor* (♂); **Eulophidae:** *Horismenus fraternus*, *Pnigalio maculipes*, *Sympiesis sericeicornis*, and *Tetrastichus* sp. (identified in this survey). **Remarks:** The completed mine is a lower surface tentiform oval blotch, which is typical of species in this genus. It is usually confined to one side of the main vein. These observations agree with the finding of Davis and De Prins (2011). Frass consists of black particles placed toward the mine axis. This is a new host record for *Horismenus fraternus*, *Pnigalio maculipes*, *Sympiesis sericeicornis*, and *Tetrastichus* sp.

Micrurapteryx occulta (Braun) (Fig. 77, 78). **Specimen data:** Mouth of Salmon Trout River 46°51.870N 87°46.435W, 4 larvae 11 Jun 2001, 2♂, 22-24 Jun 2001, Lot 1125; same site, 17 larvae 16 Aug 2004, 1♂, 6♀ 04-11 Sep 2004, Lot 1509; same site, 13 larvae 16 Sep 2006, 4♀ 30 Sep – 04 Oct 2006, Lot 1757; same site, 1 larva 30 Jun 2007, 0 adult, Lot 1802; same site, 3 larvae 24 Sep 2008, 3♀ 12–13 Oct 2008, Lot 1903; same site, 1 cocoon 27 Aug 2009, 1♂ 11 Sep 2009, Lot 1942; Conway Bay 46°53.101N 87°48.705W, 9 larvae 25 Jun 2002, 3♂ 06 Jul 2002, Lot 1295; same site, 4 larvae 23 Sep 2002, 1♀ 08-12 Oct 2002, Lot 1347; Picnic Point 46°53.056N 87°50.509W, 12 larvae 05 Jun 2006, 3♂, 3♀ 18-22 Jun 2006, Lot 1698. **Distribution:** CANADA: BC, NL, NB, NS, YT; U.S.A.: CA, CO, CT, IL, KY, NV, UT (Kirichenko et al. 2016). **Larval hosts:** *Vicia caroliniana* Walt., *Melilotus* sp., *Melilotus officinalis* (L.) Lam. (De Prins and De Prins 2005); *Lathyrus japonicus*, *Melilotus albus* Medik., *Vicia caroliniana*, *Lupinus* sp., *Caragana* sp. (Kirichenko et al. 2016). *Lathyrus japonicus* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor bedelliae*, *Pholetesor salalicus* (Mason), *Pholetesor variabilis* Whitfield (Yu et al. 2012). **Ichneumonidae:** *Diaglyptidea* sp. (identified in this survey). **Remarks:** There is usually only one mine per leaflet though occasionally two occur. This upper surface mine is a lobed blotch. Frass is expelled via a hole at the mine base, which is frequently pink. The yellowish larva exits the lower leaf surface to form an oval pale yellow, or rarely white, cocoon. Occasionally, larvae pupate in their mines with adults emerging on the upper leaflet surface. From recovery and emergence dates, there are two generations per year at HMC. This agrees with Kirichenko et al. (2016). The specimens of *Diaglyptidea* reared in this research are the first ichneumonids reported as parasitoids of *M. occulta*.

Parectopa sp. prob. *robiniella* Clemens (Fig. 79). **Specimen data:** Ives Lake Road 46°50.475N 87°50.581W, 2 larvae 17 Aug 2004, 0 adults, Lot 1517. **Distribution:**



Figures 74–81. **Fig. 74.** *Leucanthiza dircella*: vacated mine. **Fig. 75.** *Macrosaccus robiniella*: adult. **Fig. 76.** *Macrosaccus robiniella*: lower surface mine with pupal skin extended. **Fig. 77.** *Mirurapteryx occulta*: adult. **Fig. 78.** *Mirurapteryx occulta*: vacated mine. **Fig. 79.** *Parectopa* sp. prob. *robiniella*: early mine. **Fig. 80.** *Parornix conspicuella*: adult. **Fig. 81.** *Phyllocnistis populiella*: adult.

Palaearctic; **CANADA:** QC; **U.S.A.:** FL, KY, LA, ME, MD, MI, MO, NY, PA, VT, WI (De Prins and De Prins 2005). **Larval hosts:** *Amorpha fruticosa* L., *Desmodium* sp., *Galactia volubilis* (L.) Britton, *Meibomia* sp., *Robinia* sp., *R. hispida*, *R. pseudoacacia*, *R. viscosa* (De Prins and De Prins 2005). *Robinia pseudoacacia* (identified in this survey). **Parasitoids:** **Eulophidae:** *Astichus trifasciatipennis*, *Chrysocharis nitetis*, *Closterocerus* sp., *C. cinctipennis*, *C. trifasciatus*, *Elachertus inunctus*, *Hysopus benefactor* (Crawford), *Minotetrastichus frontalis*, *Phygadeuon* sp., *Sympiesis gordius* (Noyes 2018); **Braconidae:** *Pholetesor circumscriptus*, *Pholetesor nanus*; **Ichneumonidae:** *Gelis acarorum* (L.), *Gelis proximus* (Förster) (Yu et al. 2012). **Remarks:** This upper surface mine begins along the main vein. The initial mine is elongate and lobed lying upon the main vein. The mine origin is dark pinkish brown with frass expelled through a lower surface hole. Weaver and Dorsey (1967) described and illustrated all known *R. pseudoacacia* leaf miners, including the distinctive mine shape of this species on *R. pseudoacacia*.

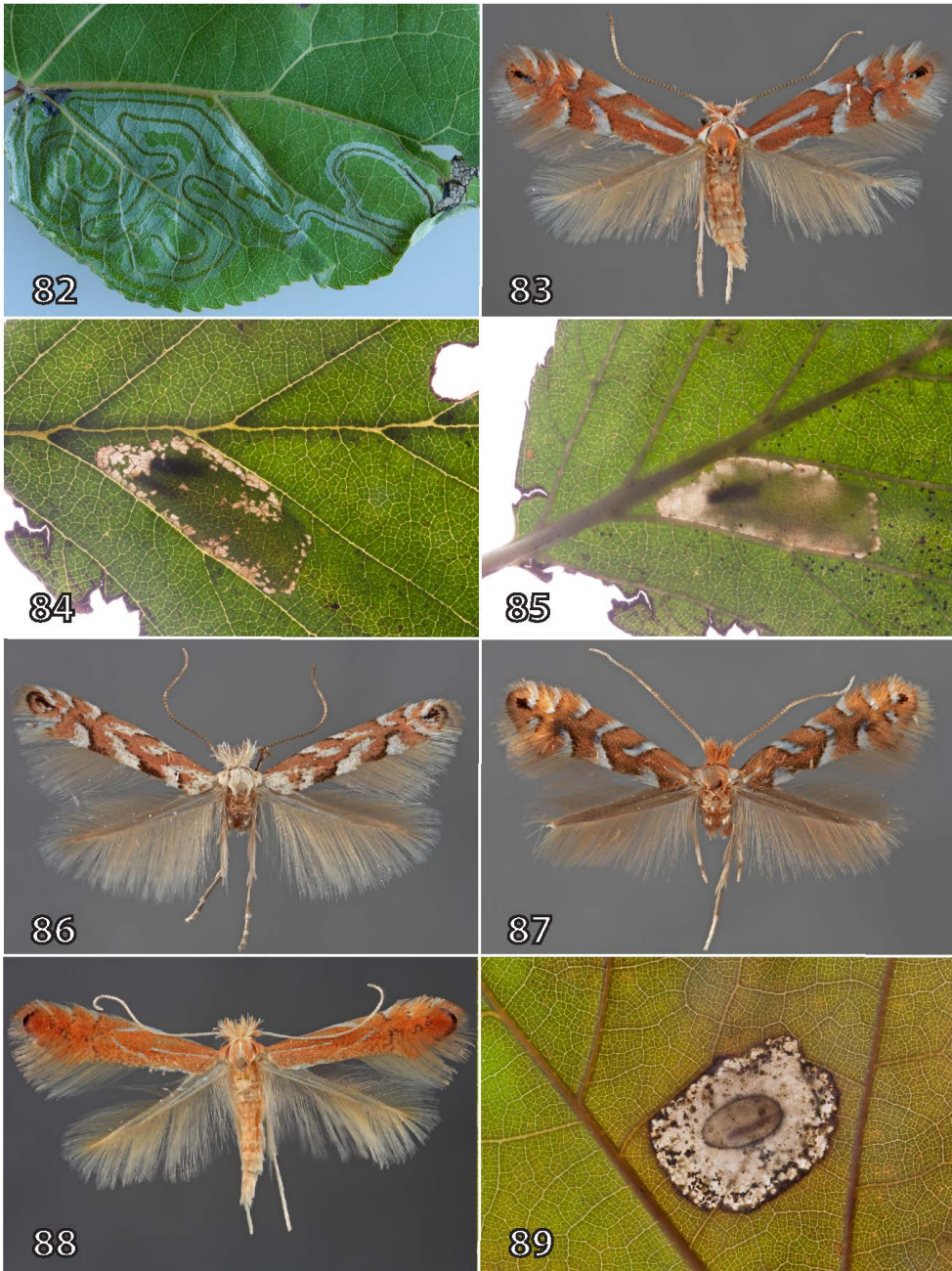
Parornix conspicuella (Dietz) (Fig. 80). **Specimen data:** Trout Lake 46°85.5582N 87°88.9509W, 3 larvae 27 Sep 2002, 1♀ after wintering, Lot 1364. **Distribution:** **CANADA:** QC; **U.S.A.:** ME, MI, PA, VT (De Prins and De Prins 2005). **Larval hosts:** *Betula nigra* (De Prins and De Prins 2005). *Betula papyrifera* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor ornigis* (Yu et al. 2012). **Eulophidae:** *Phygadeuon maculipes* (identified in this survey). **Remarks:** The mine is tentiform and on the lower surface and placed at the leaf margin. Spotty feeding to the upper epidermis occurs around the mine perimeter. The mature larva exits its mine and folds a leaf edge to pupate in a brownish silken cocoon. This is a new host record for *Phygadeuon maculipes*.

Phyllocnistis populiella Chambers (Fig 81, 82). **Specimen data:** River Styx 46°50.627N 87°1.300W, 2 larvae 24 Jun 2002, 0 adult, Lot 1293; same site, 7 larvae 14 Jul 2003, 2♂ 20–21 Jul 2003, Lot 1409; Jensen homestead 46°53.656N 87°53.131W, 14 larvae 17 Jul 2003, 1♂, 1♀ 26 Jul 2003, Lot 1421; same site, 10 larvae 17 Jul 2003, 1♂ 22 Jul 2003, Lot 1423; same site, 4 pupae 16 Aug 2004, 1♂ 25 Aug 2004, Lot 1511; same site, 4 pupae 16 Aug 2004, 1♂ 28 Aug 2004, Lot 1514; same site, 4 pupae 27 Aug 2009, 0 adults, Lot 1940. **Distribution:** **CANADA:** BC, QC; **U.S.A.:** CO, IL, KY, ME, MI, NY, VT (De Prins and De Prins 2005). **Larval hosts:** *Populus alba* L., *P. balsamifera* L., *P. deltoides* Marsh., *P. grandidentata*, *P. nigra* L., *P. tremuloides*, *P. × canadensis* Moench. (De Prins and De Prins 2005). *Pop-*

ulus alba (Lots 1293, 1409), *P. tremuloides* (Lots 1421, 1514, 1940), and *P. balsamifera* (Lots 1423, 1511) (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis coptodiscae* Yoshimoto, *C. nephereus*, *C. pentheus*, *Cirrospilus cinctithorax*, *Closterocerus trifasciatus*, *Horismenus livivorus* Crawford, *H. microgaster* (Ashmead), *Pediobius albipes*, *P. bucculatricis*, *Phygadeuon maculipes*, *Sympiesis gordius* (Noyes 2018). **Eulophidae:** *Closterocerus trifasciatus* and *Pediobius albipes* (identified in this survey). **Remarks:** This easily recognized mine is a narrow sinuous trail on the upper leaf surface just below the epidermis. It is usually initiated and terminates near the leaf edge. Frass is a continuous central trail. When feeding is complete, the larva folds a small part of the leaf perimeter and then pupates within it in a white cocoon.

Phyllonorycter alnicolella (Walsingham) (Fig. 83, 84, 85). **Specimen data:** Flat Rock 46°54.520N 87°55.355W, 13 mines 22 Sep 2011, 1♀ after wintering, Lot 2034. **Distribution:** **U.S.A.:** CA, ME (De Prins and De Prins 2005). **Larval hosts:** *Alnus incana* (L.) Moench (Walsingham 1889). *Alnus viridis* (Chaix) DC. (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** The lower surface mine is an oval blotch confined by adjacent lateral veins. Feeding progresses upward at the mine perimeter then continuing inward. When fully fed, much of the upper leaf around the mine perimeter and toward its center is consumed. Larvae mining the upper sides of leaves of *A. incana*, as observed initially by Walsingham (1889) and repeated by others (Braun 1908, De Prins and De Prins 2005), was not observed in this rearing. That observation may have arisen when Walsingham observed larvae nearing completion of their feeding. The larval feeding pattern reported here is typical of species in this genus. Both mine surfaces of the feeding larva are illustrated. Pupation occurs in the mine with adult emergence from the lower leaf surface, which is also typical of many *Phyllonorycter* species.

Phyllonorycter apparella (Herich-Schäffer) (Fig. 86). **Specimen data:** Jensen homestead 46°53.656N 87°53.131W, 7 mines 16 Aug 2004, 1 ♀ 31 Aug 2004, Lot 1513. **Distribution:** Palaearctic; **CANADA:** AL, BC, MB, NS, ON, QC, SK, YT; **U.S.A.:** AK, CO, CT, ME, MD, MA, MI, MN, NM, OH, VT, VA, WA (De Prins and De Prins 2005). **Larval hosts:** *Populus balsamifera*, *P. grandidentata*, *P. × conescens* (Ait.) Sm., *P. tremuloides* (Davis and Deschka 2001). *Populus tremuloides* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor circumscriptus*; **Ichneumonidae:** *Itoplectis alternans* (Gravenhorst) (Yu et al. 2012).



Figures 82–89. **Fig. 82.** *Phyllocnistis populiella*: completed mine in *Populus tremuloides* with pupal leaf edge fold. **Fig. 83.** *Phyllonorycter alnicolella*: adult. **Fig. 84.** *Phyllonorycter alnicolella*: upper mine surface. **Fig. 85.** *Phyllonorycter alnicolella*: lower mine surface. **Fig. 86.** *Phyllonorycter apparella*: adult. **Fig. 87.** *Phyllonorycter auronitens*: adult. **Fig. 88.** *Phyllonorycter basistrigella*: adult. **Fig. 89.** *Phyllonorycter basistrigella*: lower mine surface with cocoon.

Braconidae: *Pholetesor* sp. 3 and *Pholetesor* (♂); **Eulophidae:** *Closterocerus trifasciatus* (identified in this survey). **Remarks:** The completed mine of this solitary miner is the usual lower surface oval tentiform shape. Also, the larva pupates in its mine as is usual for the genus. This is a new host record for *Closterocerus trifasciatus*.

Phyllonorycter auronitens (Frey and Boll) (Fig. 87). **Specimen data:** Gillet Landing 46°51.870N 87°46.435W, 10 mines 25 Sep 2000, 1♂ after wintering, Lot 1081. **Distribution:** CANADA: QC; U.S.A.: CT, KY, ME, MA, NC, VT (De Prins and De Prins 2005). **Larval hosts:** *Alnus serratula* (Aiton) Willd., *A. rubra* Bong., *A. rugosa* (DuRoi) Spreng., *A. incana* (L.) Moench (De Prins and De Prins 2005). *Alnus incana* (identified in this survey). **Parasitoids:** **Eulophidae:** *Sympiesis gordius* (Noyes 2018). **Eulophidae:** *Tetrastichus* sp. (identified in this survey). **Remarks:** The mine is the usual *Phyllonorycter*-type, a lower surface tentiform shape with the miner pupating in its mine and emerging from the upper surface. Frass is balled at the basal end of the mine. This is a new host record for *Tetrastichus* sp.

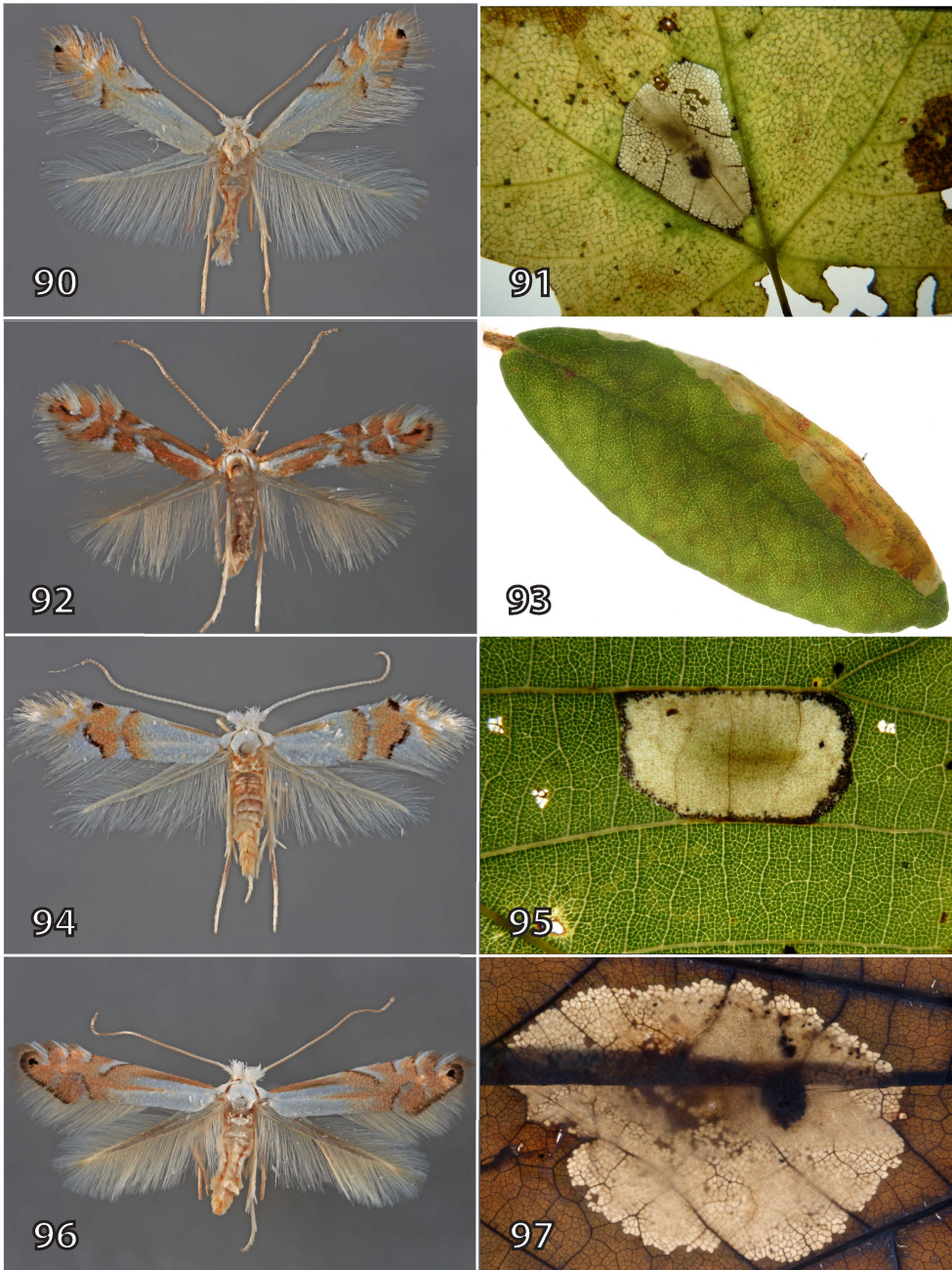
Phyllonorycter basistrigella (Clemens) (Fig. 88, 89). **Specimen data:** Breakfast Roll Mountain 46°50.892N 87°49.783W, 7 completed mines 26 Sep 2001, 0 adult, Lot 1259; same site, 2 mines 04 Oct 2009, 2♀ after wintering, Lot 1957. **Distribution:** CANADA: QC; U.S.A.: CA, CT, IL, KY, ME, MI, NY, OR, VT (De Prins and De Prins 2005). **Larval hosts:** *Quercus alba*, *Q. bicolor* Willd., *Q. castanea* Née, *Q. coccinea* Münchh., *Q. kelloggii* Newb., *Q. macrocarpa*, *Q. prinoides* Willd., *Q. prinus* L., *Q. rubra*, *Q. stellata* Wangenh., *Q. tinctoria* W. Bartram, *Q. velutina* (De Prins and De Prins 2005). *Quercus rubra* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor salalicus* (Yu et al. 2012). **Eulophidae:** *Pediobius liocephalatus*, *Sympiesis gordius* (Noyes 2018). **Eulophidae:** *Achrysocharoides reticulatus* Yoshimoto (identified in this survey). **Remarks:** The mine is located on the lower surface. Frass is clearly visible scattered through the mine. Frass also surrounds the cocoon perimeter constructed within the mine, which is characteristic of this species. The cocoon is approximately 6.0 × 3.0 mm. This is a new host record for *Achrysocharoides reticulatus*.

Phyllonorycter clemensella (Chambers) (Fig. 90, 91). **Specimen data:** Near HMC entrance gate 46°50.926N 87°48.012W, 21 larvae 25–29 Sep 2000, 9♂, 3♀ after wintering, Lot 1085; Burnt Damn 46°48.720N 87°48.772W, 6 larvae 24 Sep 2001, 1♂ after wintering, Lot 1246. **Distribution:** CANADA: QC; U.S.A.: CT, IL, KY, ME, MI, NY OH

(De Prins and De Prins 2005). **Larval hosts:** *Acer saccharinum*, *A. saccharum* (De Prins and De Prins 2005). *Acer saccharum* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor ornigis* (Yu et al. 2012). **Braconidae:** *Pholetesor* (♂); **Eulophidae:** *Sympiesis sericeicornis* (identified in this survey). **Remarks:** This lower surface mine is initiated near the leaf base. As it enlarges its sides are restricted by adjacent veins. Once the mine size has been established on the lower surface, feeding continues to the upper surface from the perimeter toward its center. Frass is concentrated in a ball at the mine center. Pupation occurs within the mine in an oval cocoon approximately 5.0 × 3.0 mm. This is a new host record for *Sympiesis sericeicornis*.

Phyllonorycter ledella (Walsingham) (Fig. 92, 93). **Specimen data:** Stoutamire Bog, 46°52.628N 87°50.658W, 1 larva 29 Sep 2000, 0 adult, Lot 1101; same site, 3 larvae, 26 Sep 2001, 0 adults, Lot 1258; same site, 7 mines 08 May 2002, 2♂ 28 May - 01 Jun 2002, Lot 1281. **Distribution:** CANADA: QC; U.S.A.: CA (De Prins and De Prins 2005). **Larval hosts:** *Rhododendron columbianum* (Piper) Harmaja; (De Prins and De Prins 2005); *Rhododendron (Ledum) groenlandicum* (Oeder) Kron and Judd (identified in this survey). **Parasitoids:** **Eulophidae:** *Achrysocharoides zwoelferi* (Delucchi) (Noyes 2018). **Remarks:** This solitary larva forms an upper surface wide-track mine, which is quite unusual for Michigan species in this genus since other species typically locate their mines on the lower leaf surface. The mine frequently begins along the leaf margin widening as it progresses apically. Frass is deposited in a trail as black particles along the mine perimeter. Most mines are confined to one side of the main vein and only cross that vein near the leaf apex. The completed mine has several wrinkles parallel with the mine and leaf axis and above its pupation site. The larva winters in its mine and emerges as an adult in spring. It is likely that the larva feeds in the spring since mines recovered in the fall were not completely formed and did not produce adults. This observation is also confirmed from other unpublished rearings of this species by the first author recovered at another Upper Michigan site. Walsingham (1889) made his observations in California and did not indicate larval wintering. There appears to be only one generation per year at HMC.

Phyllonorycter lucetiella (Clemens) (Fig. 94, 95). **Specimen data:** HMC entrance gate 46°50.926N 87°48.012W, 9 larvae 27 Sep 2000, 1♂, 1♀ after wintering, Lot 1097; Borrow Pit at Howe Lake 46°53.140N 87°56.919W, 9 larvae 20 Sep 2003, 1♂, 2♀ after wintering, Lot 1445. **Distribution:**



Figures 90–97. **Fig. 90.** *Phyllonorycter clemensella*: adult. **Fig. 91.** *Phyllonorycter clemensella*: lower surface of completed mine. **Fig. 92.** *Phyllonorycter ledella*: adult. **Fig. 93.** *Phyllonorycter ledella*: completed mine (reared from Upper Peninsula but not at HMC). **Fig. 94.** *Phyllonorycter lucetiella*: adult. **Fig. 95.** *Phyllonorycter lucetiella*: lower surface of completed mine with frass around its perimeter. **Fig. 96.** *Phyllonorycter lucidicostella*: adult. **Fig. 97.** *Phyllonorycter lucidicostella*: lower surface of completed mine.

CANADA: QC; **U.S.A.:** CT, FL, GA, IL, KY, ME, MD, MI, NY, PA, TX, VT (De Prins and De Prins 2005). **Larval hosts:** *Ostrya virginiana*, *Tilia americana*, *T. × europaea* L., *T. vulgaris* Hayne (De Prins and De Prins 2005); *Tilia americana* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor ornigis* (Yu et al. 2012); **Eulophidae:** *Achrysocharoides gahani*, *Chrysocharis laomedon*, *Pediobius liocephalatus*, *Sympiesis gordius* (Noyes 2018). **Encyrtidae:** *Ageniaspis bicoloripes* (identified in this survey). **Remarks:** The completed lower surface mine is confined by adjacent veins with frass tightly appressed to the mine perimeter. Pupation occurs in the mine with its oval cocoon clearly visible. This is a new host record for *Ageniaspis bicoloripes*.

Phyllonorycter lucidicostella (Clemens) (Fig. 96, 97). **Specimen data:** Flat Rock 46°54.520N 87°55.355W, 5 completed mines 24 Sep 2002, 3♀ after wintering, Lot 1352; Quarry-Fen 46°53.839N 87°53.607W, 4 larvae 17 Sep 2003, 1♂, 1♀ after wintering, Lot 1437. **Distribution:** **CANADA:** ON, QC; **U.S.A.:** AL, CT, IL, KY, ME, MI, NY, PA, VT (De Prins and De Prins 2005). **Larval hosts:** *Acer saccharinum*, *A. floridanum* (Chapm.) Pax., *A. saccharum*, *Quercus alba* (De Prins and De Prins 2005); *Acer saccharum* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor ornigis* (Yu et al. 2012). **Eulophidae:** *Achrysocharoides clypeatus* (Miller), *Sympiesis gordius* (Noyes 2018). **Ichneumonidae:** *Stictopisthus* sp. (♂, hyperparasitoid) (identified in this survey). **Remarks:** The mine is located on the lower surface and limited by adjacent veins. Frequently the solitary larva will remove most tissue to the upper epidermis. Frass is concentrated in a ball toward the mine center. Maier and Davis (1989) suggest Glenn's statement (Godfrey et al. 1987) of rearing this species from *Quercus alba* and *Quercus* species is unlikely. RJP has focused on rearing leaf miners from the 11 most commonly occurring *Quercus* species throughout Michigan for 10 years and has not encountered *P. lucidicostella* on any *Quercus* species. Host use is unknown for the specimen of *Stictopisthus* reared in this research.

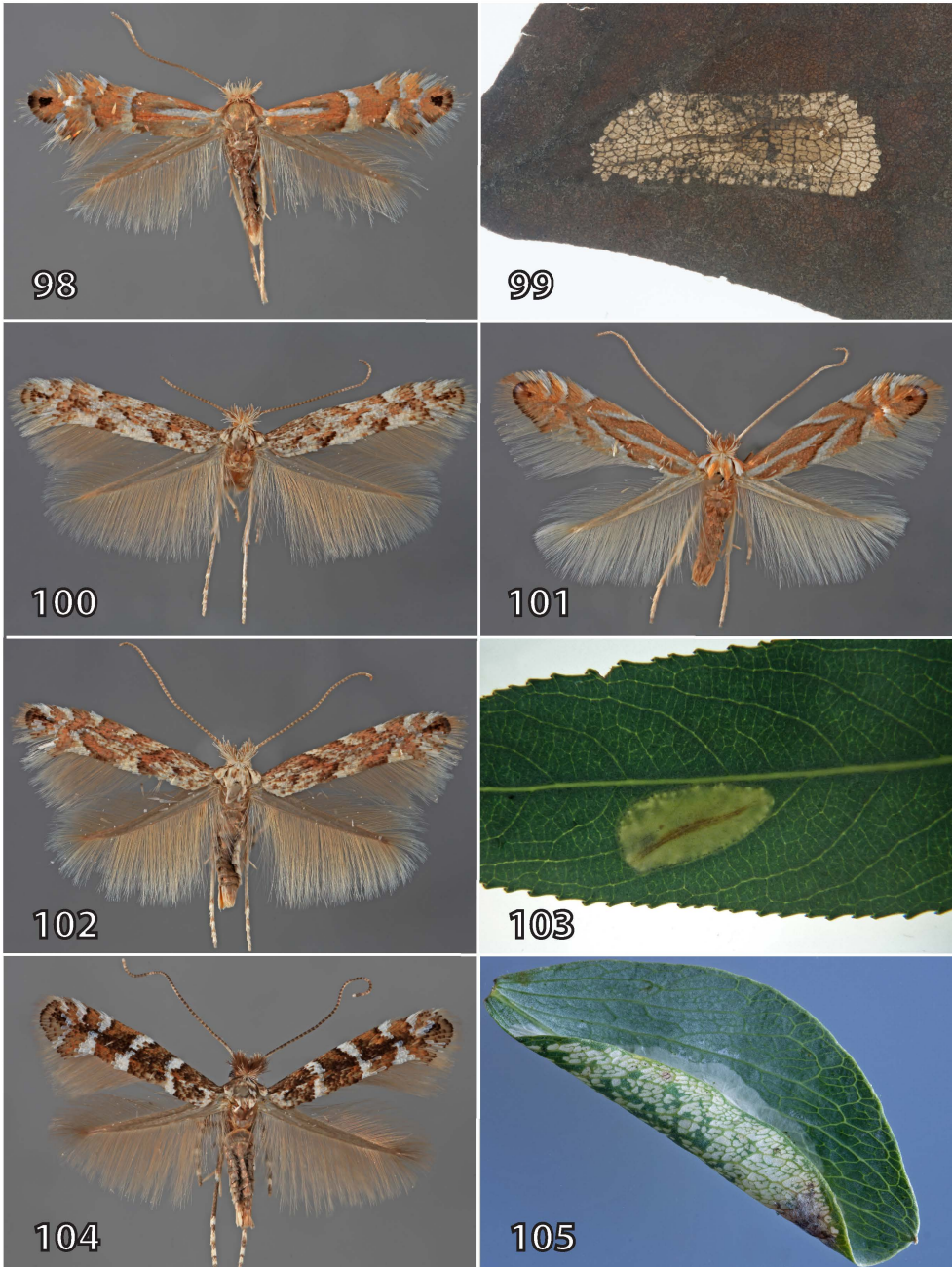
Phyllonorycter martiella (Braun) (Fig. 98, 99). **Specimen data:** Quarry-Fen 46°53.839N 87°53.607W, 3 larvae, 17 Sep 2003, 1♂ after wintering, Lot 1439. **Distribution:** **CANADA:** BC, NS, QC; **U.S.A.:** KY, ME, MI, NC, VT (De Prins and De Prins 2005). **Larval hosts:** *Betula lenta*, *Betula* sp. (De Prins and De Prins 2005); *B. papyrifera* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Braconidae:** *Pholetesor* sp. 1 (identified in this survey). **Remarks:** The completed lower surface mine is confined by adjacent veins.

Frass is scattered throughout the mine. Pupation occurs in an oval cocoon at the mine center. The specimen of *Pholetesor* reared in this research is the first species of Braconidae reported as parasitic on *P. martiella*.

Phyllonorycter nipigon (Freeman) (Fig. 100). **Specimen data:** Jensen Homestead 46°53.656N 87°53.131W, 4 completed mines 16 Aug 2004, 1♂, 29 Aug 2004, Lot 1512. **Distribution:** **CANADA:** AB, BC, ON, QC, SK; **U.S.A.:** AK, CA, CO, ID, MI, MN, MT, WA, WY (De Prins and De Prins 2005). **Larval hosts:** *Populus angustifolia* James, *P. balsamifera*, *P. balsamifera trichocarpa* (Torr. and Gray), *P. × acuminata* Rydb. (*P. angustifolia* × *deltoides* Marsh.), *P. fremontii* S. Watson, *P. nigra*, *P. tremuloides* (Davis and Deschka 2001, De Prins and De Prins 2005); *P. balsamifera* (identified in this survey). **Parasitoids:** **Eulophidae:** *Sympiesis gordius*, *S. sericeicornis*, *S. stigmata*, *Zagrammosoma americanum* Girault, *Z. multilineatum* (Ashmead) (Noyes 2018). **Eulophidae:** *Closterocerus trifasciatus* (identified in this survey). **Remarks:** The completed mine of this solitary larva is an elongate lower surface tentiform blotch. Frass consists of black particles at the mine perimeter. This is a new host record for *Closterocerus trifasciatus*.

Phyllonorycter ostryaefoliella (Clemens) (Fig. 101). **Specimen data:** Mt. Lake Boat House 46°86.720N 87°90.333W, 26 larvae 28 Sep 2000, 2♂, 3♀ after wintering, Lot 1099; trail end to Cedar Creek 46°82.279N 87°93.114W, 11 larvae 25 Sep 2001, 1♂, 1♀ after wintering, Lot 1244. **Distribution:** **CANADA:** NS, ON, QC; **U.S.A.:** CT, IL, KY, ME, NY, VT (De Prins and De Prins 2005). **Larval hosts:** *Ostrya virginiana* (De Prins and De Prins 2005); *O. virginiana* (identified in this survey). **Parasitoids:** **Eulophidae:** *Achrysocharoides arienascapus* (Miller) (Noyes 2018); **Braconidae:** *Pholetesor ornigis*, *Rhysipolis decorator* (Haliday) (Yu et al. 2012). **Eulophidae:** *Chrysocharis* sp.; **Bracconidae:** *Rhysipolis decorator* (identified in this survey). **Remarks:** One to five mines occur per leaf though the larva is solitary. The mine is typical of several species in this genus being lower surface and tentiform. Frass is generally scattered through the mine though occasionally clumped. This is a new host record for *Chrysocharis* sp.

Phyllonorycter salicifoliella (Chambers) (Fig. 102, 103). **Specimen data:** Stone House 46°50.627N 87°51.300W, 6 mines 17 Aug 2004, 3♂, 1♀ 28 Aug - 01 Sep 2004, Lot 1516. **Distribution:** **CANADA:** AB, BC, ON, QC; **U.S.A.:** CA, CO, CT, ID, IL, KY, ME, MD, MA, MI, NJ, NM, NY, OH, VA, WA (De Prins and De Prins 2005). **Larval hosts:** *Populus balsamifera*, *P. gran-*



Figures 98–105. **Fig. 98.** *Phyllonorycter martiella*: adult. **Fig. 99.** *Phyllonorycter martiella*: completed and vacated mine. **Fig. 100.** *Phyllonorycter nipigon*: adult. **Fig. 101.** *Phyllonorycter ostryaefoliella*: adult. **Fig. 102.** *Phyllonorycter salicifoliella*: adult. **Fig. 103.** *Phyllonorycter salicifoliella*: lower surface of completed mine. **Fig. 104.** *Protolithocolletis lathyri*: adult. **Fig. 105.** *Protolithocolletis lathyri*: lower leaf surface with mined leaf edge rolled under.

didentata, *P. tremuloides*, *Salix alba* L., *S. amygdaloides* Andersson, *S. babylonica* L., *S. bebbiana* Sarg., *S. bonplandiana* Kunth., *S. caroliniana* L., *S. eriocephala* Michx., *S. exigua* Nutt., *S. integra* Thumb., *S. lasiolepis* Benth., *S. lutea* Nutt., *S. monticola* Bebb, *S. purpurea* L., *S. scouleriana* Barratt ex Hook., *S. sericea* Marsh., *S. × rubens* Schrank (= *S. alba* × *fragilis*), less commonly on *Populus* sp., *P. balsamifera*, *P. grandidentata*, *P. tremuloides* (De Prins and De Prins 2005). *Salix* sp. (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor ornigis*, *Pholetesor salicifoliellae* (Mason), *Pholetesor variabilis*; **Ichneumonidae:** *Allophosternum foliicola* (Yu et al. 2012). **Eulophidae:** *Achrysocharoides zwoelferi*, *Aprostocetus* sp., *Chrysocharis* sp., *C. boriquenensis* Hansson, *C. coptodiscae*, *C. walleyi* Yoshimoto, *Cirrospilus cinctithorax*, *Closterocerus trifasciatus*, *Diglyphus pulchripes* (Crawford), *Sympiesis gordius*, *S. sericeicornis* (Noyes 2018). **Braconidae:** *Pholetesor* sp. 1 (identified in this survey). **Remarks:** This species forms a typical *Phyllonorycter* oval lower surface tentiform mine. Frass is scattered around the mine perimeter and balled near the mine apex. Pupation occurs within the mine. A single wrinkle, parallel with the long axis of the mine, is evident on the lower leaf surface.

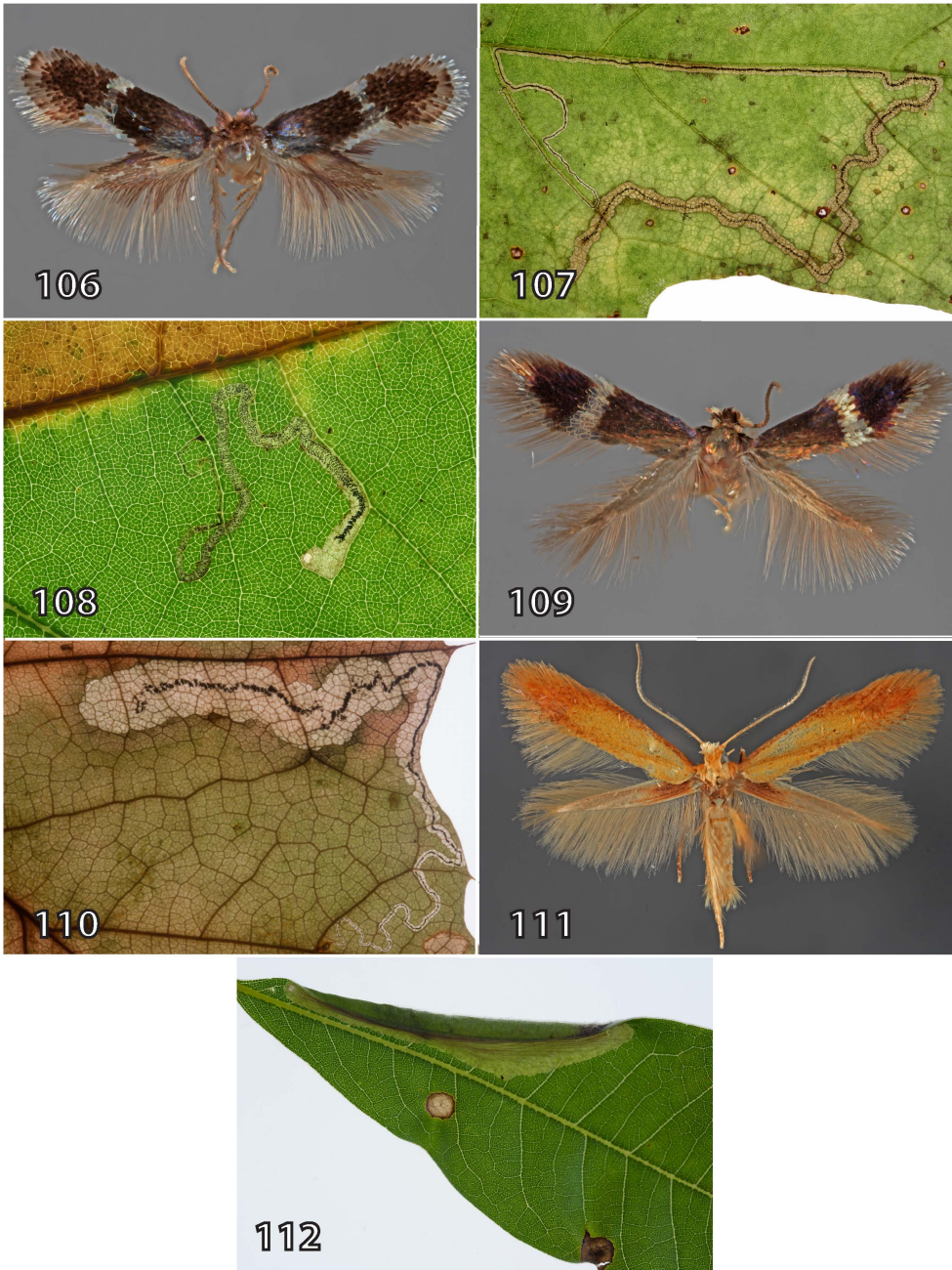
Protolithocolletis lathyri Braun (Fig. 104, 105). **Specimen data:** Gillet Landing 46°51.870N 87°46.435W, 3 larvae 16 Sep 2006, 1♀ 29 Sep 2006 Lot 1756; same site, 2 larvae 19 Sep 2007, 0 adults, Lot 1841; same site, 9 larvae 27 Aug 2009, 3♂, 4♀ 08-15 Sep 2009, Lot 1941. **Distribution:** CANADA: MB; U.S.A.: CA (De Prins and De Prins 2005); CA, CO, MI, NM, UT (ex specimen data labels, NMNH, 29 Mar 2011). **Larval hosts:** *Lathyrus venosus* Willd. (De Prins and De Prins 2005), *L. japonicus* (Priest 2007); *L. japonicus* (identified in this survey). **Parasitoids:** **Eulophidae:** *Chrysocharis coptodiscae*, *Pnigalio minio* (Noyes 2018). **Braconidae:** *Pholetesor salicifoliellae*, *Rhysipolis pallipes* (Provancher) (Yu et al. 2012). **Eulophidae:** *Sympiesis sericeicornis* (identified in this survey). **Remarks:** The completed lower surface mine is a long oval tentiform shape and placed on one side of the main vein. Wrinkling of the lower mine surface causes the leaflet to roll downward partially covering the mine. Feeding frequently extends to the upper surface appearing as stippling and at times with complete removal of all green tissue. The larva pupates inside the mine. This is its first published location in Michigan but its second recovery. An adult specimen in the NMNH was recovered by A. Braun with label reading, “30 Jul 1943, Huron Mountains, MI.” No larval host data were mentioned. Combining Braun’s adult recovery date with emergence dates reported

here, there appears to be at least two generations per year in this survey area. This is a new host record for *Sympiesis sericeicornis*.

Nepticulidae

Glaucoclepis saccharella (Braun) (Fig 106, 107). **Specimen data:** Loop Road 46°50.627N 87°51.300W, 1 larva 13 Sep 2005, 1♂ after wintering, Lot 1652. **Distribution:** CANADA: ON, QC; U.S.A.: OH (Wilkinson and Scoble 1979). **Larval hosts:** *Acer rubrum*, *A. saccharum* (Braun 1917); *Quercus rubra* (Wilkinson and Scoble 1979); *A. saccharum* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** The very long linear upper surface mine gradually widens along its entire length. Frass is deposited as a continuous central line of black particles along the entire mine. The terminus is approximately 1.3 mm wide. The pale yellow-green larva exits the upper surface prior to pupating in a flat brown 2.1 × 1.2 mm oval cocoon. A previous rearing, Lot 1435 recovered in 2003, has a similar mining pattern, but the adult did not agree in coloring with the adult description of Braun (1912).

Stigmella sp. *macrocarpa* (Freeman) (Fig. 108). **Specimen data:** Lily Pond, 46°50.892N 87°49.783W, 4 larva (2 dead) 18 Sep 2006, 0 adult, Lot 1761; same site, 1 larva 18 Sep 2006, 0 adults, Lot 1771. **Distribution:** CANADA: BC, ON; U.S.A.: AR, FL, IL, KY, MA, MI, NY, OH, PA, VA (Newton and Wilkinson 1982). **Larval hosts:** “Red and scarlet oaks, and probably Chestnut” (Braun 1917); *Castanea dentata*, *Quercus alba*, *Q. macrocarpa*, *Q. palustris* Münchh., *Q. rubra* (Wilkinson and Scoble 1979). *Quercus rubra* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Braconidae:** *Gnaptodon nepticulae* (Rohwer) (identified in this survey). **Remarks:** The upper surface linear mine begins at a vein, gradually widening during its development. Frass is deposited across the mine through most of its length. At approximately mid-length frass particles are arranged in concave bands across the mine. In the last few millimeters of deposition the frass bands are narrowed covering less than a third of the central mine width. The terminal mine width is 1.8–2.5 mm. The full grown larva is bright green, exits the lower leaf surface, and forms a white cocoon approximately 1.3 × 2.5 mm. These observations agree especially well for this species as described by Braun (1917) but also of those provided by Lindquist and Harnden (1970) and Wilkinson and Scoble (1979). *Gnaptodon nepticulae* would be the first species of Braconidae reported as parasitic



Figures 106–112. **Fig. 106.** *Glaucolepis saccharella*: adult. **Fig. 107.** *Glaucolepis saccharella*: completed and vacated mine. **Fig. 108.** *Stigmella* sp. prob. *macrocarpae*: completed and recently vacated mine. **Fig. 109.** *Stigmella quercipulchella*: adult. **Fig. 110.** *Stigmella quercipulchella*: completed and vacated mine. **Fig. 111.** *Coptotriche citrinipennella*: adult. **Fig. 112.** *Coptotriche citrinipennella*: completed mine in *Quercus imbricaria*. Mine from Lower Peninsula.

on *S. macrocarpae* pending unequivocal host identification.

Stigmella quercipulchella (Chambers) (Fig. 109, 110). **Specimen data:** Lily Pond 46°50.892N 87°49.783W, 2 larvae 29 Sep 2000, 1♀ after wintering, Lot 1100. **Distribution:** CANADA: ON; U.S.A.: IL, KY, OH, PA (Newton and Wilkinson 1982). **Larval hosts:** *Quercus rubra* (Wilkinson and Scoble 1979); *Q. palustris*, *Q. marilandica* Münchhausen (Newton and Wilkinson 1982); *Quercus rubra* (identified in this survey). **Parasitoids:** None reported (Yu et al. 2012, Noyes 2018). **Remarks:** The upper surface mine begins at a secondary vein. It meanders and widens gradually the first half of its length. The last half is significantly wider measuring 4.5 mm across at its terminus. Frass is distributed in a thin central line throughout the mine length. The single pale green larva exits the upper leaf surface. It pupates in a tan cocoon 2.3 × 1.7 mm.

Tischeriidae

Coptotriche citrinipennella (Clemens) (Fig. 111, 112). **Specimen data:** Breakfast Roll Mountain 46°51.015N 87°49.601W, 1 larva 26 Sep 2000, 1♂ after wintering, Lot 1095. **Distribution:** CANADA: NS, ON, QC; U.S.A.: AR, DC, IN, KY, MA, MO, NJ, NY, NC, OH, PA, TX, VA, WV (Braun 1972); MI (Nielsen 1998). **Larval hosts:** *Quercus imbricaria*, *Castanea dentata* (Braun 1972); *Q. rubra* (identified in this survey). **Parasitoids:** **Braconidae:** *Pholetesor ornigis* (Yu et al. 2012). **Eulophidae:** *Chrysocharis* sp., *Pnigalio* sp. (Noyes 2018). **Remarks:** The mature upper surface mine is elongate and constructed along the leaf edge. As the mine enlarges, the leaf edge is rolled onto the upper surface hiding most of the mine. The larva pupates in its mine, emerging from the distal end. Though this was the only specimen observed during the survey, RJP has found it the most common species mining *Quercus* in both Michigan Peninsulas. This is a new record for the genera *Chrysocharis* and *Pnigalio*.

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Stone House on Ives Lake at the Huron Mountain Club, Marquette County, MI. It provides both lodging and work area for visiting researchers.

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